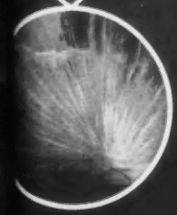
CHEMISTRY



Reports From The Meeting
At Cleveland Of The

American Chemical Society

50¢

Thirty-third Year

A SCIENCE SERVICE PUBLICATION

Sumer is Icumen in!

➤ MOST OF US must be familiar with the fable of the grasshopper and the ant.

For those who have forgotten Aesop's little homily, it concerns the proverbially industrious ant who spent his long warm summer days working hard to store up food for the following winter. Came along a grasshopper, frivolous by nature, who asked him what he was doing and why. On being told what and why, the grasshopper expressed his preference for hopping about and singing, and went away and did just that for the rest of the summer. The following winter, the grasshopper, becoming hungry, appealed to the ant for a loan. The ant pointed out the error of his ways and told him to go away and starve: which he did.

While not wishing to condone the action of the ant from an ethical standpoint, I would like to point out the applicability of the moral to be drawn from this little saga to those of us who will shortly be starting our summer vacations.

If you have ever looked over the personnel advertisements in a commercial magazine, you may have noticed that many employers seem to be demanding that somewhat rare combination: youth and experience. How may this experience be gained at an early age? One means is to find a scientific vacation job; in this way you may, if you will excuse the cliché, learn while you earn.

It is not too late to find rewarding summer employment in the field of science. Perhaps your best course is to write to any local industries that may have research laboratories, to the Federal Agency concerned with your interest, and possibly to the employment offices of any universities in your locality.

One final thought: it may be that, like a young lady of our acquaintance, you will learn through this experience that you do *not* want to become a scientist after all. It is always as well to discover this before it is too late!

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Gases Could Enfeeble

The American Chemical Society held its 13th National Meeting in Cleveland, Ohio, from April 5 to 14, 1960. The following reports have been taken from papers that were presented at that meeting.

▶ LONG-SECRET DATA on the killing abilities of new U.S. gases were reported to the meeting of the American Chemical Society. Chemists were also told of indications that the USSR is well advanced in chemical and biological warfare.

Dr. Conrad E. Ronnelberg, a chemist at Denison University, Granville, Ohio, said a single B-52 bomber could drop enough gas to kill 30% of the people in a city the size of Washington, D.C. Loaded with biological agents (450 pounds) the bomber could kill 75% of the people in a 34,000-square-mile area.

The blast of a 20-megaton H-bomb would have an effective area of 36 square miles.

Gen. Marshall Stubbs, the Army's Chief Chemical Officer, said chemical and biological agents would not destroy a nation but would seriously reduce its fighting abilities.

He told the ACS that the USSR is advanced in chemical and biological warfare. Soviet microbiologists, he said, have conducted biological tests in an isolated location over a long period and now have the ability to make a successful chemical or biological attack.

He added that Soviet officials claim 85% of their population has completed a ten-hour anti-air defense course that includes instruction on chemical and biological agents. There are gas masks and shelters in many public buildings in Russia.

Dr. William H. Summerson of the Army Chemical Corps said nerve gases are the worst. They kill in minutes by overstimulating the nervous system. The exhausted victims collapse and die. American soldiers are now equipped with simple hypodermics of an antidote, atropine.

But civilians have no protection. Dr. Summerson said a bit of nerve gas powder the size of an aspirin can kill 350 animals. There is no detectable odor or color, only warning symptoms such as difficulty in breathing.

Dr. Summerson said chemical agents would make an area deadly for a day or two but that germ warfare could start an epidemic that could spread to a much larger area.

Dr. LeRoy D. Fothergill of the U.S. Army Biological Warfare Laboratory, Fort Detrick, Frederick, Md., reported that diseases such as typhoid, cholera, anthrax, and rabies could be spread by dropping aerosol bombs. The organisms could also be put into water, food and drug supplies, or they could lie dormant in the soil.

Early detection of the germ agents is crucial but difficult. American scientists are known to be working on the problem.

One detection method has already proved itself fairly successful in quickly identifying biological agents in the air. Living tissues always react to germs producing antibodies to fight them. The new technique uses fluorescein, a material that makes the antibodies glow under ultraviolet light.

American researchers have also developed protective masks for civilians, but they are not yet available.

The masks are much more compact than those distributed in American cities in World War II. They offer protection against even the nerve gases, but not against the blister gases. World War I victims of one blister gas, mustard gas, still lie without hope of recovery in veterans' hospitals.

But the new gases are more humane. Some kill quickly. Others knock a victim out or reduce his ability to fight but do not permanently disfigure.

Some at the ACS meeting observed that chemical and biological warfare has been a "tabu" subject until recently. Guessing at why this subject is now being brought out into the sunlight, some say the USSR might use gas and germ warfare in a future war. The chances of these agents being used may be increased if atomic testing is ended.

Thus, many Civil Defense workers are eager to get information to the public so it will prepare for the worst, and thus make the worst less likely.

General Chemistry

Heavy Water Concentrated By Detergents

➤ HEAVY WATER, used as a moderator in some nuclear reactors, may be concentrated in natural water by certain detergents.

E. Griffin Shay of the Atlantic Refining Co., Philadelphia, told the American Chemical Society meeting that these detergents become less soluble in water at higher temperatures, and reach a point on heating at which they become turbid. This point was, he found, at a lower temperature in heavy water (deuterium oxide) than in ordinary water.

By adding special detergents to water containing deuterium oxide, then heating it, a precipitate may be obtained. The upper layer is found to be richer in deuterium oxide than was the original starting solution. Detergents causing this effect are of the nonionic, ethylene oxide type.

Chromatography Used To Detect Arson

➤ GAS CHROMATOGRAPHY now can be used to identify materials suspected of having been used by arsonists to start fires. W. J. Cadman of the Orange County Sheriff's Office, Santa Ana, Calif., and Theron Johns of Beckman Instruments, Pasadena, Calif., told the meeting that materials used to accelerate a fire may sometimes be identified after separation by distillation, extraction, or other methods.

However, these "accelerators" are often so altered by the loss of their

more volatile constituents, the additions of outside impurities, or chemical change in the heat of the fire, that these methods are no longer effective.

Gas chromatography, a method of separating gases according to their different rates of flow through narrow tubes, now provides a valuable naw weapon in the fight against arson.

Bulk of IGY Findings Expected in 1960

➤ BETWEEN 90% and 95% of the information collected during the International Geophysical Year is expected to be in by the end of this year according to Drs. Hugh Odishaw and Pembroke J. Hart of the U.S. National Committee for the IGY.

More than 30,000 scientists of 67 nations have been getting information on subjects ranging from space probes to ocean depths since the beginning of the IGY in July, 1957.

This information is now being collected at three centers—one in Washington, D.C., one in Moscow, and one that is a cooperative effort on the part of various scientific societies in Europe and Japan. According to Dr. Hart, the nations seem to have lived up to their international agreements on the exchange of information.

The final results of the IGY research will, he expects, comprise 30 volumes of about 400 pages each, of which the first nine volumes have already been published.

Trout Protector Measures Lamprey Killing Chemicals

➤ CONCENTRATIONS of the chemical used to poison fish-killing lampreys may now be measured quickly and accurately, making it easier to ensure that concentrations of the poison, called TFM, do not become great enough to harm trout and other desirable fish.

The lamprey is an eel-like parasite which attaches itself to other fish and, by sucking out their body-juices, eventually kills them. Some years ago they were mostly found in the St. Lawrence River; however, since then, they have migrated as far as the Great Lakes where they have played havoc with the fishing industry. Between 1946 and 1955, for example, the trout harvest from Lake Michigan alone dropped from 6,500,000 pounds to a mere 34,000.

Prof. M. A. Smith of Bucknell University, Lewisburg, Pa., told the American Chemical Society meeting that TFM (3-trifluoromethyl-4-nitrophenol), has been found effective in killing lamprey larvae, while leaving other fish unharmed, providing the TFM concentration does not rise above eight parts per million.

An instrument called a photoelectric colorimeter determines the quantity of TFM, at these low concentrations, with an accuracy better than 0.2 parts per million. Prof. Smith explained that the instrument registers a vivid yellow color when the concentration becomes too high. The new technique has been developed to give rapid, accurate results in the field. The water sample to be tested is passed through a fine screen and treated with alkali, in the presence of which TFM gives the brilliant yellow color, the intensity

of which is measured with the photoelectric colorimeter.

Dr. Vernon C. Applegate of the U.S. Bureau of Commercial Fisheries, Rogers City, Mich., and B. G. Herbert Johnson of the Fisheries Research Board of Canada, London, Ontario, were co-authors of the report.

Fresh Water from the Sea More Cheaply than Ever

➤ A SIMPLE evaporation system is the basis of a new million-gallon-a-day plant to make drinking water from the sea, soon to be built at Freeport, Texas.

F. C. Standiford Jr. of the W. L. Badger Associates, Inc., Ann Arbor, Mich., told the American Chemical Society, that fresh water will be produced from the Gulf of Mexico at about one dollar a thousand gallons. He also said that a similar plant of ten times the size could produce fresh water at about 35¢ a thousand gallons, considered to be an economical price.

The Freeport plant will be the first of five large plants to be built for the Office of Saline Water of the Department of the Interior in an attempt to ease the growing water shortage in parts of the United States.

The process, which has been tested over the last two years in a pilot plant in North Carolina, uses the cheapest evaporators and materials, made possible by special techniques that combat corrosion and the build-up of scale.

Twelve evaporator units are connected in series, so that condensing steam from each will heat the water in the next. Temperatures up to 250 degrees Fahrenheit are used. It has been found that corrosion is largely due to oxygen in the sea water, and this is therefore removed on the way in. To prevent scale formation, more scale is introduced, suspended in the sea water. It is then found that fresh scale deposits on this rather than on the walls of the boilers, where it would gum up the works.

Medical Chemistry

Atoms Switched to Make Potent Antihistamines

➤ A NEW CLASS of highly active antihistamine drugs has been found.

Miss Ellen Donoghue, a chemist for CIBA Pharmaceutical Products Inc. and her colleagues have been working on a chemical group of substances called isoindolines. They believed they could make a substance with antihistamine activity by pulling an atom out of the isoindoline molecule's nucleus and putting a different atom in the empty space.

It worked. The new compound was a fairly good antihistamine, but the chemists were not satisfied. They began knocking atoms out of the sides, top, bottom, middle, front and back of the new molecule. Each time they substituted an atom, they got a new compound.

There were hundreds of compounds, some not so active, and others quite powerful. The one that packs the biggest punch is pyrindene, which has a carbon atom in place of nitrogen in the nucleus. It is more than twice

as potent as the best antihistamine known.

In two years of clinical testing, 2,500 patients took three to four milligrams of pyrindene per day. The new drug was "very effective," Miss Donaghue said, and there were few side reactions.

Coauthors of the paper were Miss Patricia Wenk and Drs. C. F. Huebner, S. Sury and J. A. Nelson.

Strep-Fighter Made In One Chemical Step

➤ A ONE-STEP chemical synthesis of powerful germ-fighting agents was reported by D. Edward J. Modest, head of the laboratories for organic chemistry at the Children's Cancer Research Foundation, Inc., Boston.

He said a wide variety of 2,4-diaminopyrimidine compounds have been synthesized in a one-step chemical process. The substances actively inhibit folic acid metabolism in some biological systems, especially in the streptococcus faecalis, the germ that often causes human urinary infections.

New Sugar May Aid Cancer Research

➤ A SUGAR has been discovered that may add to man's understanding of cancer and diabetes.

Known as a heptose, it was isolated from a rat liver extract and was described to the American Chemical Society meeting by three scientists of Tufts University School of Medicine, Medford, Mass.

Clarification of its function in living tissue could be very useful in combating diseases in which sugar metabolism is abnormal, it was explained.

A lack of vitamin B-1 (thiamine) in test rats' diets interferred with the capacity of rat tissue (brain, heart and lung) to form the sugar, Dr. Hsien-Gieh Sie said. When thiamine was added to the tissue in a test tube, heptose formation did not resume, indicating that the vitamin deficiency had inflicted grave damage.

The heptose may also be found in other mammals, fish, birds, reptiles, plants and bacteria, Dr. Vijai N. Nigam said. He cited this widespread natural occurrence of the heptose as a measure of its biological significance. A heptose is a sugar containing seven carbon atoms arranged in sequence.

The heptose was first isolated by heating rat liver enzymes with a phosphate compound of the common sugar glucose. The project was headed by Dr. William H. Fishman, research professor of oncology at Tufts and director of cancer research at the New England Center Hospital, Boston.

Rubber and Plastic Chemistry

Silicone Rubber Irradiated While Stretched

➤ SILICONE rubber can be improved by stretching it, then irradiating it with high energy electrons while stretched.

M. Prober, G. D. Cooper and F. F. Holub of the General Electric Research Laboratory, Schenectady, N.Y., said samples of peroxide cross-linked silicone rubber treated this way had

higher tensile strengths than similar samples that had not been irradiated or had been irradiated without stretching.

This is thought to be due to the very extensive rearrangement of bonds within the rubber that occurs on irradiation.

Laminate Adhesion Promoter Described

➤ LAMINATES which combine the heat sealability, tear strength and chemical resistance of polyethylene, or thermal insulation of "Mylar" polyester film, cellophane, and aluminum foil can be made faster, easier, and more economically with poly(dibutyl titanate).

Used as an adhesion promoter between the polyethylene and the other materials, the titanate ester adds less than four-thousandths of a cent per square foot to the cost of the laminate, Charles L. Gray, Jr. of Du Pont told delegates to the Americal Chemical Society meeting. End result, he said, is easier processing for film converters who make sheet materials for packaging foods, chemicals and other materials.

"Tyzor" AC, as the commercial form of this compound is called, is a compromise between the commonly used mixture of tetraisopropyl titanate and tetrastearyl titanate — which hydrolizes so fast, especially in humid weather, that it may lead to very short primer-bath life and erratic adhesion — and the titanium acetylacetonate ester which, with a relatively slow hydrolysis rate, is harder to process, particularly in water systems, because of the slower evaporation of water. The compromise hydrolysis rate of "Tyzor" AC permits faster operation of laminating equipment and provides a wider polyethylene extrusion temperature range in the laminating process.

Fluorine Rubber Resists Gasoline, Extreme Cold

➤ A NEW SYNTHETIC RUBBER, completely nonflammable, highly resistant to attack by gasoline and corrosives, and still soft and resilient at 60 degrees below zero was reported to the American Chemical Society meeting.

Now being tested for use in rubber-coated military uniforms to protect servicemen against the heat of nuclear blasts, the new rubber is also expected to be useful in gaskets, hoses, sealing compounds, and other jobs in which a rubber must perform at low temperatures and in the presence of petroleum products, or chemical corrosives.

The new rubber, a member of a family of plastics and rubbers called "nitroso-fluorocarbon" rubbers was reported by Drs. George H. Crawford and D. E. Rice of the Minnesota Mining and Manufacturing Company, St. Paul, Minn., and Dr. Juan C. Montermoso of the U.S. Army Quartermaster Corps.

With the increasingly rigorous conditions under which modern weapons are required to operate, the need is constantly arising for tougher and more versatile materials. Other rubbers of the same general type have proved to be most satisfactory at high temperatures, but tend to become stiff at low temperatures.

Radiation Process Speeds Up Plastics Grafting

➤ A METHOD of attaining speedier attachment of styrene to polyethylene by radiation-induced graft copolymerization, was described before the American Chemical Society meeting.

The method involves the dilution of styrene with methanol, according to reports on experiments in this field conducted by three scientists of Radiation Applications, Inc., a nuclear research firm in Long sland City, N.Y. Their paper, prepared jointly by Dr. George Odian, Albert Rossi and Edward Trachtenberg, was delivered by Dr. Odian.

The RAI report said: "The accelerative effect in styrene grafting is ascribed to the fact that the growing graft polymer chains have become sufficiently immobilized, through the introduction of methanol during radiation, to inhibit their rate of termination." Such a decrease, he explained, leads to a higher over-all rate of graft copolymerization.

"If this accelerative phenomenon is found to be generally applicable to various monomer-polymer systems," Dr. Odian went on, "it may open up a broad new field of plastics modifications."

Polyethylene Bonded To Copper

➤ A CHEMICAL METHOD of coating copper with plastic — of particular value for sealing transoceanic cables— has been described.

The bonding method forms chemical grippers on polyethylene plastic that cling to the copper, eliminating the need for adhesives, Dr. Arthur T. Spencer of the Bell Telephone Laboratories, Murray Hill, N.J., told the American Chemical Society meeting.

The method, which also may be used in flexible printed circuits and microwave devices, make use of the oxidation of the polyethylene in contact with an oxide film on the metal in a short-time, high-temperature molding operation. There is no intermediate adhesive layer.

High and reproducible bond strengths are achieved by the process between a wide range of polyethylenes and copper alloys bearing at least 85% copper. Bonds formed by this method failed through tearing in the polyethylene rather than by a lack of adhesion at strength values at least several times those obtained by methods now in commercial use.

Co-author of the paper was Richard G. Baker.

Acid Wastes Reclaimable

➤ NEARLY a billion gallons of waste acid now being dumped into streams and coastal waters by the steel industry may be reclaimed by a new process developed by Ionics, Inc., Cambridge, Mass. The process is expected not only to eliminate the problem of water pollution from this source, but also to save money for the users because dissolved iron usually thrown away is recovered with the waste acid.

Science Talent Search
Project Report

BOREON

by NANCY ANN KLICKMAN
Marywood School, Evanston, Illinois

Nancy Klickman, 18, was a winner in the 19th Science Talent Search. She hopes to take her degree in chemistry, and subsequently, to engage in research and teaching.

I FIRST became interested in boron through several magazine articles which discussed newly discovered uses for boron and boron compounds. After I had tentatively decided on a topic for my project, I noticed that the most frequently asked question about it was: "What is boron?" Therefore, I determined that the purpose of my project would be to show simply and graphically what boron was and what it and its compounds did.

In doing preliminary research for my project I consulted several public libraries and wrote approximately twenty letters to companies and agencies connected with various aspects of boron chemistry.

During the research period, I decided to include in my project a demonstration of the use of spectroscopic analysis in determining the presence of boron.

Since I was attempting to show non-chemists what boron is, I started my work with two familiar compounds, boric acid and borax. All other boron compounds were made from these two.

By the relatively simple process of heating, I transformed the white crystals of boric acid into a clear, brittle, supercooled liquid, boric oxide:
$6H_3BO_3 \xrightarrow{\text{heat}} 3B_2O_3 + 9H_2O$.
At the highest temperature obtainable with a bunsen burner, the oxide is a viscous mass which cools immediately on removal of heat. The only way to remove it from the crucible in which it is prepared is to insert a glass rod and pull the rod up slowly. The oxide forms long strands, the thickness of which depends upon the rate at which the rod is removed. The process is not unlike pulling taffy.

From the oxide I prepared boron in the same manner as Moissan. Boric oxide is reduced with magnesium according to the equation: $B_2O_3 + 3Mg \xrightarrow{\text{heat}} 3MgO + 2B$.

It was here that a major difficulty was encountered. The mixture of boric oxide and magnesium had to be maintained at red heat for fifteen minutes. The burners available in our laboratory were incapable of doing this, and there was no prospect of obtaining a blast burner or any other similar apparatus. Several burners of the type with an air intake at the bottom were available, however. One of these I fitted with a glass tube and rubber stopper. The glass tube extended up inside the tube of the burner forming two concentric tubes. The inner tube was to supply the compressed air. A small hand vacuum cleaner provided compressed air. The vacuum cleaner had a three to four

▶ NANCY ANN KLICKMAN *shows her science display at an exhibition held in Washington as a feature of the Nineteenth Annual Science Talent Search. Nancy was one of the 40 S. T. S. winners who were chosen from over 29,000 high school seniors throughout the country.*

inch circular exhaust opening which normally led to the collection bag. This opening was so constructed as to make it impossible to obtain a stopper to fit it. A rubber glove was fitted over the end of the outlet of the vacuum cleaner, and tied down. A finger of the glove was fitted with a stopper and tubing. When the burner was tried it worked satisfactorily. Several batches of the mixture were heated using this burner. Subsequently, the same burner was used by other students in a glassmaking project. From the type of glass made it was estimated the burner reached a temperature of 1300° C.

After the material was heated it was leached with hydrochloric acid several times, filtered, and dried.

The product obtained was a dark brown, amorphous powder, corresponding to the description of boron prepared in this manner.

By treating boric acid with hydroflouric acid in the molar ratio of $4HF : 1H_3BO_3$ by reacting boron trifluoride ($6CaF_2 + 6H_2SO_4 + 2B_2O_3 \xrightarrow{\text{heat}} 6CaSO_4 + 4BF_3\uparrow + 6H_2O$) gas with water, I obtained two samples of fluoboric acid, a strong acid which will etch glass.

From solution of borax ($Na_2B_4O_7 \cdot 10H_2O$) in water, I prepared, by double replacement, the borates of mercury, cobalt, iron, magnesium, lead, aluminum, silver, and two borates of copper. All of these borates are insoluble in water, and consequently precipitated out of a mixed solution of borax and a metal salt.

A suspension of zinc borate was prepared and used to fireproof a small piece of cloth. It, and an identical untreated piece were then exposed to a burner flame, whereupon only the untreated cloth burst into flame.

Boron nitride, sometimes called "inorganic graphite," was prepared by reacting ammonium chloride and borax. This compound is resistant to acids and alkalies.

A simple demonstration of why borax softens water was prepared. A concentrated solution of magnesium, calcium, and iron salts was introduced into a flask of concentrated borax solution. The precipitate which removes the troublesome ions from the water was readily apparent. This demonstration also illustrated the way in which compounds can be formed by double replacement.

To show the interrelation of the two compounds I had used, I prepared borax by reacting sodium carbonate with boric acid and I made boric acid by reacting a borax solution and sulfuric acid.

One final step remained. That was to show that the compounds I had produced were really boron compounds. This was done in two ways. The first of these was through the use of a simple spectroscope. The spectroscope available had to be cleaned, and the badly nicked edges of the slit had to be restored to knife sharpness.

When the spectroscope was working satisfactorily, attempts were made to preserve the spectra by photographing them. A camera was attached to the eyepiece and a black cloth was spread over the camera and spectroscope to keep out stray light. The first exposures taken with a Polaroid Land Camera proved the film not to be sensitive enough. Kodak colored film was next tried and several prints were obtained of boron spectra which agree with data found on the flame spectrum of boron.

Attempts were made to photograph the spectra on X-ray film, but the correct exposure time could not be found.

A second method was used to identify the borates, since they cannot be made to produce a boron flame spectrum. All borates were tested by adding H_2SO_4 and alcohol to them and igniting. All burned green to give a positive test.

I am presently continuing my project. I am now concentrating my work on the boron trihalides which are typical Lewis acids. Because of this property they catalyze, or enter into, many organic reactions. Recently ,many new boron polymers have been prepared which can withstand extremes in temperature and stress. I am now doing research into the

possibilities of producing specific boron compounds to meet specific requirements.

I plan to carry on my work in boron chemistry throughout college, for it has been mainly this project which caused me to decide upon chemistry as a career.

Gas Blanket Cools Space Ship

➤ WRAPPING manned space vehicles with a thin blanket of gas may be the solution to the problem of air-friction heating during re-entry into the earth's atmosphere.

While re-entry difficulties have been overcome for ballistic missiles, they are still unsolved for the manned space vehicles and maneuverable missiles of the future. Ballistic missiles must endure extreme heat for only about 30 seconds. Maneuverable and manned vehicles, on the other hand, must endure heat for longer periods — up to 50 minutes — because they will enter the atmosphere at shallower angles and will decelerate at slower rates than ballistic missiles. Deceleration forces of ballistic missiles exceed those that the human body can withstand.

The skin heating problem of all space vehicles originates in what is called the boundary layer, a thin film of gas molecules from the atmosphere that collects on the skin of any object flying through the atmosphere. At speeds of 14,000 miles an hour and more, the gas temperature around the nose can rise to a dangerous 15,000 to 18,000 degrees Fahrenheit. If this heat is not dissipated, the vehicle will burn up like a meteor as it streaks through the atmosphere.

Scientists at California Institute of Technology have used a wind tunnel to blow hot air at high speed at a nose cone to simulate a missile's flight.

At the same time, they arranged to have helium gas ejected from a hole in the front of the cone.

The onrushing hot air was found to spread the helium in a thin, continually flowing blanket over the cone's surface. The helium, in turn, prevented the hot shock wave layer of air over the nose from transferring much of its heat to the cone, and absorbed and carried away most of the heat.

The Caltech researchers, headed by Prof. Lester Lees and Dr. Clark B. Millikan, have calculated that a protective layer of helium only one-sixteenth of an inch thick flowing over the nose of a missile two feet in diameter would permit the cone's skin temperature to be held to a maximum of about 2,500 degrees, well within the tolerances of certain materials.

Research has also shown that a comparatively small amount of helium is required to keep a vehicle's skin from overheating. Prof. Lees estimates that on a 4,000-mile flight lasting about 20 minutes at an altitude of 20 to 30 miles, only about 15 pounds of helium — second lightest of all the elements and a great heat absorber — would be required to blanket the nose of a typical manned space vehicle.

Old Wine in New Bottles

by FRANK E. CLARKE

Reprinted from the A.S.T.M. BULLETIN

It is safe to say that everyone considers water a genuine necessity. On the other hand, few on first thought would consider it a competitor, in novelty and glamour, to space-age wonders like nuclear power plants, earth satellites, and moon rockets. Perhaps we are so close to this commonplace substance that our picture of it is not clearly focused. It is time we took a new and better look, for water undoubtedly is destined eventually to become the most important of our natural resources.

The Inside Dope

➤ OUR NEW look should start inside the water molecule, where modern concepts of structure reveal features that make for interesting potentialities.

Concepts of the water molecule have matured with the orderly transition from classical through atomic to nuclear physics. No longer is the hydrogen atom pictured according to the basic Bohr concept of a satellite electron orbiting about a simple proton nucleus in a series of roughly circular concentric paths representing as many energy levels. Instead, it is represented as a relatively complex nucleus surrounded by a variety of somewhat abstract electron clouds,each representing a possible standing wave pattern, the product of a particular mass-energy relationship of the electron. These clouds are graphic representations of Heisenberg's famous uncertainty principle that says, in effect, it is certain only that the electron is somewhere in one of these clouds. The more certain its location, the less certain its movement, for the means of measuring one property hinders measurement of the other.

The nucleus within these standing wave patterns of electrostatic influence may be the basic proton variety some of us studied in high school or the heavy or extra-heavy nuclei of deuterium (one neutron plus one proton) or tritium (two neutrons plus one proton). In any case, there will be an energy-level pattern for the nuclear particle rivaling that of the satellite electron and too complicated for proper discussion here.

The oxygen atom is built on the same pattern as that of hydrogen, but it is for more complicated because of its greater number of electrons and nuclear particles. For example, the eight electrons must jockey for position in the electron clouds according to Pauli's exclusion principle, which permits only two (and these with opposite spins) to occupy a given orbital. The nucleus may have 8, 9, 10, or even 11 neutrons in addition to its complement of protons, yielding atomic weights of 16, 17, 18, or 19.

One would certainly guess that these two components will produce a great variety of molecules (isotopes), and they do. Water, once considered to be H_2O, new comes in at least 18

different varieties of molecular structures, not counting compounds of the short-lived oxygen-19 (less than 1 min half-life. Of these, deuterium oxide D_2O representing about 300 parts per million, is the best known and most widely used special variety (isotope). Tritium compounds are attracting more and more attention.

The macrostructure of water also is complex. For example, there is evidence that each body of water, even the ocean, is a single gigantic molecule, or lattice, which might be written $(H_2O)_n$.

It is paradoxial that the more one learns about the structure of water, the more difficult it becomes to depict it in terms of everyday concepts. Could this be the commonplace substance we have taken for granted?

Interesting New Properties

Locked in the complex atomic and molecular structures of water are the secrets to many unusual properties which continue to appear as explorations in science proceed. Self desalting of sea water, presumably by fractional crystallization and stratification was reported by the *USS Nautilus* on its historic transit under the polar cap. This process is so effective that a 10- or 12-ft. layer of fresh water separates the sea from the ice ceiling in some places. Objects of proper specific gravity will sink through this fresh layer and stop abruptly on the surface of the sea. This is a tantilizing phenomenon to scientists who are attemping to produce the same salt separation by control of crystal growth during freezing.

Equally interesting is the recent evidence that minute nuclei of undissolved solid and gaseous matter cause weak spots in the otherwise strong rope-like structure of water, so that it tears and cavitates, with damaging effects on water-handling equipment. What laymen would buy such a story on first reading? Yet experimenters working on the basis of this theory have reduced cavitation by pressurizing water and the troublesome nuclei to lessen the likelihood of their releasing bubbles and starting tears.

The heavyweight relatives of ordinary water have some peculiar properties too. Deuterium oxide (ordinary heavy water) will not quench thirst, nor will it support plant life. When more is learned about tritium oxide and the other isotopic forms, the list of interesting new properties undoubtedly will expand.

Profitable New Uses

While most of us are seeking new sources of water for the already too numerous uses, others are finding new, interesting uses for the water we already have. Ordinary tap water is being used to indicate radiation intensities by means of the Cerenkov glow, a ghostly bluish-white light it emits when bombarded with charged particles traveling at speeds greater than that of light in water. The high speed is generated by radiation in a vacuum. The wavelength and intensity of the glow indicate the velocity and mass of the impinging particle.

Another somewhat more familiar application based on impinging particles involves the exceptional capacity of deuterium oxide to act as a neutron moderator in fission reactions. In a reactor, the cross-sectional characteristics of the deuterium nucleus are just right for slowing bombarding neutrons, without trapping them, so that

they land with a dull thud on the fuel nuclei, with devastating fission effects.

Use of tritium oxide (T_2O) concentration in determining make-up rates in ground waters, particularly captive well waters, is just as interesting. Radioactive T_2O formed by cosmic effects in the atmosphere has a half-life of about 12 years so that its ratio to other water molecules is a real tattletale. Accurate knowledge of water make-up rate is important in seeking dumping grounds for radioactive wastes.

Production of breathing oxygen for the crews of long-submergence submarines by distillation of sea water and electrolysis of the distillate is a less glamorous, but a far more important new use for water. When an electrolyzer of this type is perfected, man can live under water until he runs out of food or gets homesick.

Traveling a little further into the fantastic, it is conceivable that one might eventually split water into its ions (H^+ and OH^-), and maintain these free radicals immobile with liquid helium refrigeration near absolute zero until their immense recombining energies are reclaimed in rocket engines or other special applications. If you are skeptical of this possibility, better recalibrate your attitude against skepticisms of a decade or two ago.

Even many water contaminants are destined to become blessings instead of burdens. The ocean is the master vault of many minerals, and dividends are accumulating with time. For example, one oceanographer estimates that the concentration of aluminum in the sea will double in the next thousand years. How long it will be before it is profitable to process 1000 tons of sea water to obtain three grams of tin, no one can say. However, it is reasonably certain that men soon will be extracting the manganese-rich nodules from the ocean bottoms.

It's in the Stars

Despite the fairy-tale flavor of this excursion through the looking glass, it is safe to say the water carnival hasn't even started. Space-age technology is demanding more and more power and obtaining fewer and fewer miles per calorie. One day, present convential sources of power will be depleted, and nuclear fission, by that time, may be an impracticable means of supplying the demand. Nuclear fusion is the logical answer to this predicament. Considering mass relationships of earth substances, only the traces of deuterium and tritium, which occur in all natural waters are suitable raw materials for a workable fusion process. The reaction $T^3 + D^2 = He^4 + n^1 + 17.6$ mev (million electron volts) could generate billions of Btu of Energy per pound of water. The estimated 10^{17} lb. of deuterium in the oceans thus could provide millions of times more energy than all fission sources put together.

The tritium-deuterium fusion is greatly complicated by the necessity of temperatures ranging from 45,000,000 to 100,000,000°C. To harness it man must learn to confine the intense reaction, perhaps magnetically, and to withdraw its energy gradually instead of explosively. This will take a while, but when it is accomplished, water at last will provide us with an almost infinite source of energy — literally the energy of the stars.

Not Without Problems

Progress invariably causes problems, and water has created its share. The chloride stress-corrosion cracking threat in nuclear-powered, stainless-steel steam generators is a familiar example. Snow clogging of fuel lines and filters in jet aircraft by freeze-out of dissolved water at high altitudes is a less familiar, but equally troublesome, example. Conductivity problems in radar cooling systems due to traces of metallic impurities in the cooling water have caused headaches. Significant radioactive contamination of industrial and domestic water supplies is a definite possibility today, although it was scarcely heard of a few years ago. One can only guess what new problems may accompany further excursions in water technology.

Solution of these many problems involves development of a multitude of control tests and quality standards for which the fundamental research scientist has little time. Fortunately, technical groups like the ASTM have shouldered a large share of this responsibility. Committee D-19 on Industrial Water has arranged timely symposia to provide previews of problem areas and give its task groups flying starts at seeking solutions. New task groups, like those on radioactive aspects of water, have been created as necessary. This effort has yielded real dividends. ASTM's micro methods for dissolved oxygen and chloride ion played major roles in early studies of the stress-corrosion cracking problem. Its highly sensitive flame photometer method for sodium gave high-pressure boiler operators a new, effective tool for studying steam quality, and its ever up-to-date Manual on Industrial Water provides scientists, operators, and laymen with ready advice on many water problems. It is comforting to think that such active and effective groups will accompany the research scientist as he delves further into the secrets of water.

If history is any indication of the future, we can expect to find this ancient substance, water, in many new roles as science and technology advance with geometric strides — old wine in new bottles, to be sure. Each new use undoubtedly will become as commonplace as those we know today, and the problems associated with them probably will seem no more complex in retrospect. One can expect that each new problem will be attacked with the vigor and resourcefulness that always have characterized the field of water technology.

Summer Haze May be Petroleum

➤ THE BLUE HAZE seen over vegetated areas on a warm summer day is actually petroleum in the process of formation, according to Dr. Frits W. Went of the Missouri Botanical Gardens, St. Louis. The haze is caused by a layer of asphaltic and bituminous particles created by hundreds of millions of tons of volatile hydrocarbons and near-hydrocarbons expelled into the atmosphere annually by living plants.

These particles, Dr. Went suggests in the (Feb. 15) Proceedings of the National Academy of Sciences, eventually rain down on the earth and, in time, form petroleum. Dr. Went also suggested that the particles influence the weather and serve to regulate plant growth.

Radioisotope Tests Thickness

➤ A TECHNIQUE of dissolving Samarium-153, a low energy radioisotope, in hydrochloric acid and using the solution to measure tiny variations in wall thickness of an experimental Allison turboprop engine's vanes and blades was described in the latest *General Motors Engineering Journal*.

This comparatively novel use of an isotope in liquid form to determine thickness of GMR-235, a high temperature nickel base alloy, was developed by Dr. William J. Mayer and Walter H. Lange of General Motors Research Laboratories and William L. Shelly of Allison Division.

Although experience thus far has been limited to this specific problem the technique may be possible with other types of small, hollow extrusions or castings whose design intricacies make gauging impossible by conventional mechanical, electrical or ultrasonic means.

The Allison engine blades measured about 1¼ inches long, an inch wide and varied in thickness from .010 to .050. They were cast in a ceramic core mold, and an inspection procedure was required to detect instances in which the core may have shifted during the casting process, varying the airfoil wall thickness.

Because of a rather complicated internal structure, the wall thicknesses could not be measured by any standard procedure. An abnormally thick or thin wall section obviously would be likely to fail or rupture under the turboprop engine's extremely hot operating conditions in service.

The Mayer-Lange-Shelly report pointed out that in thickness measurements radiation energy is particularly important. A gamma energy was required so that a small change in the airfoil thickness would cause a detectable change in radiation intensity — counts per minute of radiation through the wall thickness.

Thickness of each blade and vane under test was measured at 12 locations, six on the concave and six on the convex sides. A fixture was designed to insure exact positioning of the gamma ray detectors. One of the smallest commercially available Geiger-Meuller tubes was selected for determining absorption rates of the radiation.

The samarium solution was injected into the blade or vane with a hypodermic syringe. Following examination, the liquid isotope was removed for further use and the parts cleaned in mild acid. The nuclear measurement technique leaves the parts free of any radioactivity and ready to use.

The fundamental principle of the airfoil thickness determinations was the relationship of the radiation count rate to the thickness. From these counts the researchers could plot a curve of thickness versus intensity of radiation through the vane or blade walls. Thus, standards for measurement of the wall thickness were set.

Later a number of test specimens were cut open and measured optically. The thicknesses measured with the isotope technique in most regions of the blades and vanes were within 3 to 10 per cent of optical measurements.

The isotope measurement operation was then shifted to Allison Division where sufficient blades and vanes were measured to accumulate information about core shift in the casting of these critical turboprop parts.

➤ A TECHNIQUE *for measuring wall thickness of hollow Allison experimental turbine blades is shown by Dr. William J. Mayer (left) and Walter H. Lange (right) of General Motors Research Laboratories. With William L. Shelly of GM's Allison Division, they dissolved Samarium-153, a low energy radioisotope, in hydrochloric acid, filled the hollow blade with radioactive fluid and measured radiation energy through blade walls. The same technique may be used for measuring wall thickness of other small, hollow extrusions or castings with design intricacies that make conventional gauging impossible.*

Proudly Presented

Announcing new developments in the chemical industry and newly available chemical literature.

pH Meter Has High Accuracy

➤ THE SCIENTIFIC and Process Instruments Division of Beckman Instruments, Inc., announces the marketing of its Model 76 Expanded Scale pH Meter, a direct-reading instrument for making extremely precise pH and millivolt measurements.

Designed for use by clinical, university, or industrial laboratories, the instrument incorporates both the standard 0 to 14 pH scale, and an expanded scale with a 2.0 pH full-scale range graduated in 0.1 pH units. Any two-pH-unit span can be chosen from the full 0 to 14 pH range, and read on the expanded scale. For example, readings of from 2 to 4, 3 to 5, 6 to 8, 10 to 12, or any two-unit span can be selected by the operator. Readability to 0.003 pH, seven times greater than that of the standard scale, can be made. Millivolt readings on the expanded scale are attainable over any 200 mv span in the range of 0 to 1400 mv, with a readability of 0.3 mv.

The Model 76 will make pH measurements accurate to $\pm$ 0.003 pH. It can be used for pH titrations and for oxidation-reduction and Karl Fischer titrations. Millivolt readings are accurate to $\pm$ 2 mv and repeatable to $\pm$ 0.3 mv.

For further details, write to Beckman Scientific and Process Instruments Division, Fullerton, California, for Bulletin 777.

"Crystal Gazing" Pamphlet Available

➤ A NEW PICTURE of crystal growth, based on similarities in natural phenomena, is advanced for the first time in a recent issue of *Research Comments* entitled "Crystal Gazing" published by Evans Research and Development Corporation, a New York City independent industrial research laboratory. A working theory of crystal growth would revolutionize quality control in many industries.

"Crystal Gazing," by James D. Haygood of the research staff at Evans Research, describes and illustrates how layer growth in crystallization is related to other regular patterns that occur in nature and whose structures follow definite rules. Confirmation of this concept can lead to a quantitative prediction of crystal growth.

Research Comments is a series of scientific articles published by Evans Research for the past ten years. Copies of "Crystal Gazing" can be obtained from the Development Department, RC-3, Evans Research, 250 East 43rd Street, New York 17, N. Y.

Liquid Gases Produced At New Plant

➤ R. E. LENHARD, president of Air Reduction Sales Company, has dedicated the company's newest liquid air separation plant at Fairfield, Alabama. The new multi-million dollar plant will produce over 30 tons of liquid oxygen, nitrogen and argon per day.

The Fairfield facility is one of two additional air separation plants at that site. The other, which will be completed in the Fall of 1960, will supply tonnage oxygen by pipeline to the Tennessee Coal & Iron Division of the United States Steel Corporation.

Liquid oxygen is used extensively in metal refining, welding, flame cutting and other metallurgical applications; liquid nitrogen in testing of missile and rocket components, food processing applications and the annealing of tin plate sheet; liquid argon in inert-gas-shielded arc welding, and the production of reactive metals.

Better Dyeing With New Leveling Salt

➤ DEEPER, level and solidly dyed shades on wool and/or nylon stocks, yarns or fabrics may be obtained economically with neutral dyes by using a new leveling agent developed by American Cyanamid Company.

Known as Calco Leveling Salt LV, the agent is applied with the dye under processing conditions, pH 4-6, that should be used for neutral dyes. The soft hand of wool is retained and the striped or Barré effect encountered in dyeing nylon carpeting is eliminated. This salt is also expected to solve similar problems in dyeing such other forms of nylon as hosiery and sweaters.

Calco Leveling Salt does not act as a retarding agent, which makes incomplete exhaustion of the dye bath the penalty of satisfactory appearance, but allows the colorant to dye rather than stain the cloth. As a result, shades may be matched by adding color in process, a procedure not possible with other agents of this type.

"Electronic-grade" Solvents Offer High Purity

➤ FOR THE ELECTRONICS industry — where ultra-high purity solvents are required in the processing of delicate parts — the Fisher Chemical Manufacturing Division has developed three useful solvents: "Electronic-Grade" Acetone, Trichloroethylene and Methyl Alcohol.

Each is individually lot-analyzed (this includes the important conductivity test), and ready to use as a bath to remove water, grease, grit and other materials — without leaving contaminants behind.

First Hydrar Plant Starts Up

➤ FIRST COMMERCIAL Hydrar unit for production of high purity cyclohexane from benzene has gone on stream at Gulf Oil Corporation's refinery at Port Arthur, Texas.

This latest addition to Gulf's large petrochemical processing facilities was designed by Universal Oil Products Company and built by Procon Incorporated. The new installation will add significantly to the nation's total supply of cyclohexane and will produce a high purity grade especially adapted to the manufacture of nylon. Cyclohexane is also used as a solvent in the manufacture of plasticizers and synthetic lubricants.

Feed stock for the Hydrar unit is supplied by an adjacent benzene plant.

By adding the Hydrar unit, Gulf will be able to coordinate its production of benzene and cyclohexane in accordance with fluctuations in demand for the two petrochemicals.

Available Cobalt Compounds Listed

➤ THE COBALT Information Center has prepared a listing of commercially available cobalt compounds.

This two-page summary lists 46 organic and inorganic compounds, including the new potassium cobalticyanide, and provides information on their uses, formula, per cent cobalt, molecular weight, specific gravity, crystalline form, melting point, and solubility.

Although sources of the compounds are not listed, this information is available from the Center upon request.

"Properties and Uses of Commercially Available Cobalt Compounds" will be sent to persons addressing requests on company letterhead to the Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio. Requesters abroad should write to Centre d'-Information du Cobalt, 35, rue des Colonies, Brussels, Belgium.

Chemical Film Guide Available

➤ A REVISED EDITION of the "Film Guide on Chemicals, Chemistry and the Chemical Industry" has been published by the Manufacturing Chemists' Association.

This expanded catalog now lists 182 titles. It includes alphabetical and subject indexes, a roster of distributors, and sources for films of related interest.

The films are listed by 11 categories and range in subject matter from the scope of a given chemical company to "The Petrified River — The Story of Uranium."

This Film Guide is designed for use by varied groups, but it is thought to be particularly helpful to educators. The suggested audience level is designated for each film.

Copies of the Guide may be obtained without charge from the Association, 1825 Connecticut Avenue, N.W., Washington 9, D. C.

New Chloro Compounds Offered Free for Research

➤ NEW, LOW-COST chloro compounds with reactivity characteristics similar to benzyl chloride are being offered free in research quantities of one pound or more by International Minerals & Chemical Corporation, Skokie, Illinois.

The four compounds — monochloromethyl alkylbenzenes, bis (chloromethyl) alkylbenzenes, chloromethyl methylnaphthalenes, and polychloro methylnaphthalenes — are particularly attractive intermediates; they have a higher molecuuar weight, lower volatility and 30 to 200 percent lower cost than benzyl chloride, a, a′ dichloro-p-xylene, or a-chloro-p-xylene. Many types of derivatives have been made readily in high yields, including esters, ethers, quaternary compounds and amines.

IMC foresees applications of the new chloro compounds in plasticizers, herbicides, fungicides, functional fluids, cosmetics, textiles, fabric water repellents, pharmaceuticals, inks, paint, rubber, adhesives, mastics, and lubricant additives.

Requests for free samples should go to Research, Engineering and Development Division, International Minerals & Chemical Corporation, Skokie, Illinois.

Vinyl-Based Solid Propellant

➤ VINYL, the ubiquitous plastic, has made its way into solid fuel rocket propellants.

While it is among the most fire-resistant of materials at ordinary temperatures and applications, in the solid fuel propellant polyvinyl chloride reacts with ammonium perchlorate with a powerful release of energy.

In an outstanding example of industrial compounding, Atlantic Research Corporation of Alexandria, Virginia, uses a plastisol technique to convert a mud-like slurry of vinyl resin, plasticizers, aluminum powder, and ammonium perchlorate into a powerful, extremely reliable solid fuel propellant.

The propellant powers several rockets, among which are the Arcon and Arcas, high altitude meteorological probes, as well as the PET (for propellant, experimental test) a pocket-size rocket engine that performs spin and retro functions on large rockets and missiles.

Atlantic has worked on the plastisol technique a number of years, although its program was only recently declassified. The plastisol technique was developed initially by Union Carbide Corporation for the production of vinyl raincoats during World War II, and it has since become an important industrial process, particularly in the coating of metals.

A plastisol is a dispersion of vinyl resin particles in a plasticiser. Heated to the proper temperature (about 350°F.) it fuses into a rubbery, tough material. As a binder and fuel in the missile, it locks the various components into a homogenous mass with a long service life. The unplasticized mixture stores well, allowing Atlantic Research personnel great latitude in experiment and formulation. Atlantic has been able to develop rocket fuels for temperature extremes ranging from minus 80°F. to plus 250°F. by modifying the ingredients.

➤ BY HEATING *this mudlike-slurry, Atlantic Research Corporation converts it into a stable, powerful solid fuel propellant for rockets.*

The aluminum powder added to the mixture gives the rocket a sharp boost in power.

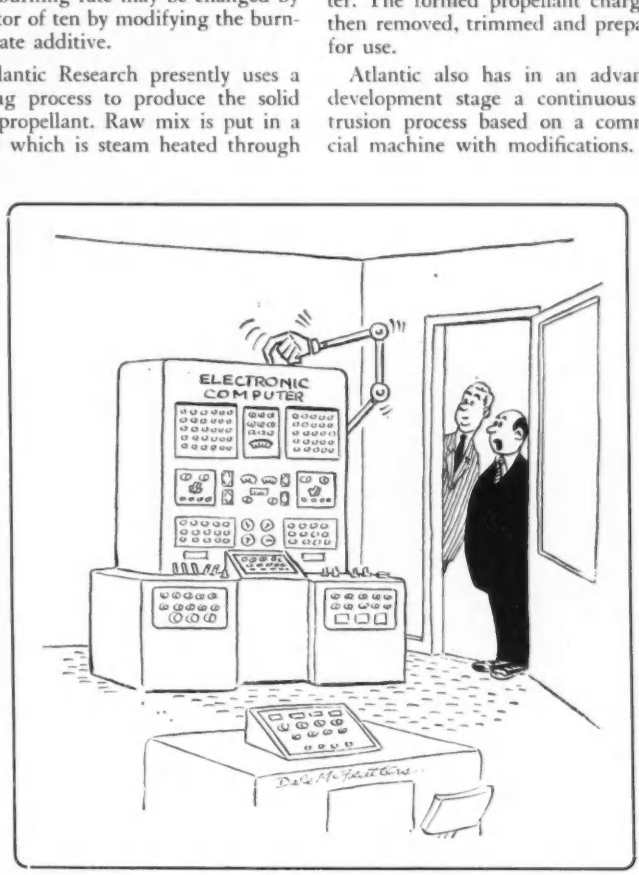
The plastisol method of solid fuel preparation offers many advantages. The fuel mass may be easily shaped and sized for a particular rocket application. It is a fast, economical process method, allowing a large throughput in a relatively small plant. The

method permits substitution of additives, high-energy ingredients, binder compositions, and oxidizers to serve different rocket requirements without significantly influencing the other properties of the basic propellant. The burning rate may be changed by a factor of ten by modifying the burning rate additive.

Atlantic Research presently uses a casting process to produce the solid fuel propellant. Raw mix is put in a mold which is steam heated through the outer jacket, and usually, the inner mandrel.

The mold shapes the mix to the design required for a particular rocket. Remotely operated valves shut off the steam and introduce cooling water. The formed propellant charge is then removed, trimmed and prepared for use.

Atlantic also has in an advanced development stage a continuous extrusion process based on a commercial machine with modifications.



"It's thinking!"

Journal of A. M. A. Uses Interlingua

➤ To PROVIDE the "most compact form of communication feasible in the present linguistic situation," the Journal of the American Medical Association has added each week an Interlingua translation to the summaries of its original articles.

The principal medical journal in America thus joins a score of other medical publications to make it possible, through this international auxiliary language, for those who have an imperfect knowledge of English to have access to new medical knowledge.

"In the medical libraries of the world, the Interlingua summaries will be permanently available for the benefit of those who have an imperfect reading knowledge of English," the Journal stated editorially. "Their facility in reading it will vary according to their language backgrounds. Those with a Romance language as their mother tongue will grasp it at first sight. Others in Europe, on both sides of the iron curtain, will do almost as well. So far, few or no factual data are available as to its scope in Russia, but the international technical-scientific vocabulary, which is the backbone of Interlingua, is known to be widely diffused in the Russian language. Any facility in reading Interlingua in the near and far East will depend mainly on a previous study of European language and would therefore not be great.

"However, Interlingua could serve as a bridge from nonoccidental scientific literature. If a medical writer in Moscow, Istanbul, Cairo, Peking, or Tokyo were to present his material in Interlingua or prepare an Interlingua summary, he would speak to the rest of the world with a single voice so that his contribution would be immediately intelligible to the occidental world."

Interlingua is being introduced into practical use, especially in scientific journals and at international conferences, with the aid of a special division of Science Service.

For those who would like to test their ability in reading Interlinqua, here is a short article on water written in that language. A translation of this passage, with which you may check your own rendering, can be found on page 44.

Aqua

H_2O es le formula chimic de aqua. Un molecula de aqua consiste de duo atomos de hydrogeno e un atomo de oxygeno. Hydrogeno libere es rar in le terra. Illo abunda in le sol e in altere stellas. Oxygeno libere forma plus que vinti pro cento de nostre atmosphera. Nos respira pro introducer oxygeno in nostre sanguine. Sin oxygeno nos non pote viver.

Nos etiam non pote viver sin aqua. Illo abunda in le terra. Apparentemente nulle aqua existe in le luna. Il es certe que nulle existe in le sol. Nos non sape si o non aqua existe in altere stellas.

Nos pensa a aqua normalmente como un liquido. Nos bania nos in illo. Nos bibe lo. Nos usa lo in nostre industrias. In le forma de rivieras e oceanos illo facilita pro nos le transporto de grande cargas.

Le substantia que nos appella aqua quando illo es liquide occurre etiam como un solido e como un gas. Le forma solide de aqua es appellate glacie. Le forma gasose de aqua es appellate vapor. Glacie e aqua e vapor es chimicamente identic. Illos omnes es H_2O.

Si H_2O es solide o liquide o gasose depende del temperatura. Le temperatura al qual aqua se transforma in vapor

es le puncto de ebullition. Le temperatura al qual aqua se transforma in glacie es le puncto de congelation. Le temperatura al qual vapor se transforma in aqua es le puncto de condensation. Le temperatura al qual glacie se transforma in aqua es le puncto de fusion. Le puncto de ebullition e le puncto de condensation es identic. Le puncto de congelation e le puncto de fusion es identic. Le scala de temperatura inter le puncto de fusion o congelation e le puncto de ebullition o condensation es dividite in 100 grados in le systema inventate per le svedo Celsius in le anno 1742. Iste grados es numerate ab zero a cento. In America nos usa rarmente le systema de Celsius. Nos prefere le systema inventate in 1709 per le germano Fahrenheit. In iste systema aqua deveni glacie a 32 grados e vapor a 212. Le distantia inter le duo es cento octanta grados. In un tertie systema — illo inventate in 1730 per le francese Réaumur — le mesme distantia es dividite in octanta grados.

Further information on Interlingua may be obtained by writing to: Science Service, Division of Interlingua, 80 East Eleventh Street, New York 3, N. Y.

New Materials Through Pressure

➤ NEW INFORMATION on the behavior of materials when subjected to great pressure and temperature is being obtained by scientists at the University of California's Lawrence Radiation Laboratory, Livermore.

The research, which may give some insight into conditions at the center of the earth, was reported recently by Berni J. Alder, staff member of the Laboratory's Theoretical Physics Division.

The great pressures, ranging up to more than a million times normal atmospheric pressure, are created through the detonation of high explosives against a metal plate. The plate, in turn, strikes the test material, creating extreme pressure and temperature effects.

Alder's main interest is to find out how much force is necessary to break down the chemical bonds present in some materials, thus producing new forms which are not found in nature.

In one series of experiments, the scientist found that at a pressure of about 700,000 atmospheres, the chemical bonds in iodine crystals are broken down causing the crystal to change from an insulator into a metallic form which readily conducts electricity.

At such pressures, he said, the electrons making up the chemical bonds are literally squeezed out of position and redistribute themselves through the crystal in such a way as to be available for the conduction of electricity.

Research with a variety of substances has indicated that with high enough pressure any insulator can be converted into a metallic form with a good ability to conduct electricity.

The scientist stated that it may be possible to create a number of new and useful high-pressure modifications of common materials which would remain stable at normal pressure.

With the techniques he is using, Alder believes it will be possible to make reliable experiments on the density and electric and magnetic properties of the material comprising the core of the earth. He hopes to conduct such studies in the near future.

Another In Series on Chemical Organizations

American Cancer Society

➤ DEDICATED teachers in many schools across the country are stimulating student interest in the cancer problem through the regular science curriculum and extra-curricular activities. Here is a challenge to which youth is responding.

Today's science teachers are instructing American youths in the facts about cancer. Largely as a result of their efforts, high school and college students are acquiring life-saving knowledge, attitudes and habits. Some students are also developing aptitudes for careers in cancer research and control. To a limited degree, even grade schools are taking part in this nationwide cancer education program.

Teachers in at least 10,146 secondary schools and 602 colleges are using materials and services supplied by the American Cancer Society. These include teaching guides, brochures, kits, and filmstrips. A new film, "Challenge to Youth," is now being shown in many classrooms across the country.

These school activities are part of the many-faceted education program conducted by the American Cancer Society and directed towards two main targets — the general public and the medical profession.

To the practicing physician, the Society makes available information about the latest developments in cancer diagnosis and therapy. This is done through lectures, symposia, conferences, closed circuit TV films, kinescopes, monographs, and through two outstanding scientific journals, *Cancer* and *CA: A Bulletin of Cancer Progress*.

To the general public, the Society brings lifesaving information about the importance of annual health checkups, cancer's seven danger signals, and facilities for early diagnosis and adequate therapy. Within this framework, the Society has a special target: youth.

Behind the effort to prepare young people for the coming conquest of cancer is the kind of grass-roots organization typical of America. It consists of 2,000,000 private citizens with a public welfare goal: total control and prevention of cancer through research, service, and education. These dedicated volunteers of the American Cancer Society function through some 3,000 county and city Units spread across the continental United States, Alaska and Hawaii. The Units are grouped into 60 chartered Divisions, each with its own Board of Directors. The Society's National Board of Directors, consisting of both men and women, is composed of 34 physicians and 34 lay volunteers. They provide representation for all sectors of American life.

The origins of the Society go back to 1913 when a small group of 15 men and women came together for the purpose of doing something about the appalling loss of lives from cancer. In those days the prognosis for the average cancer patient was a painful death. Little was known about

the disease; less was being done; nothing could be hoped for. Cancer research attracted few scientists. It was considered a futile field. The cancer problem seemed insoluble.

Today, less than 50 years later, cancer research is one of the most productive areas of scientific inquiry. The outlook for the patient who secures early treatment is hopeful. Recovery rates have improved 300 per cent. As of 1960, one million living Americans have been cured of cancer.

How was this transformation achieved?

The Society's first effort was directed to the public. The conspiracy of silence which had helped to doom the cancer patient was then broken. The Society began to inform the public about early signs of cancer and the necessity for prompt, adequate treatment.

As the public became better informed and increasingly vigilant, the need for improving cancer, training of physicians and providing more adequate facilities for cancer control became apparent. To meet this need became one of the Society's challenges. In 1929, at the Society's request, the American College of Surgeons set up standards and formulated plans for approving cancer hospitals, clinics and diagnostic facilities. The Society's professional education program moved ahead on many fronts. Cancer control was emphasized in symposia, lectures, and publications, and special fellowships were set-up for postgraduate training in cancer.

Financial support from public funds steadily increased over the years. By 1944 the Society's resources reached the million dollar mark and made it possible for the Society to expand its activities greatly.

In 1945 the Society launched a large-scale research program, and support for research has been increasing every year since the program began. To date the Society has made more than $75,000,000 available for cancer research in all parts of the country.

Grants are made to individuals and institutions; to young researchers of promise and to established scientists, (some of them Nobel Prize winners.) The Society itself has conducted important statistical studies such as the studies on the relationship of lung cancer and cigarette smoking. Its new cancer prevention study is a six-year project which will study the habits, health histories, family backgrounds and environments of one million Americans. Volunteers, specially trained for the job, are collecting the data.

In addition to programs in research and education, the Society has a service program for cancer patients and their families. The types of services vary in different parts of the country depending on the needs and available resources. However, they generally include supporting facilities for cancer detection, diagnosis, and treatment, as well as for rehabilitation of the cancer patient, provision of information services and counselling, loan closets of hospital equipment, surgical dressing, transportation, housekeeping service, home nursing, palliative medication, and supportive care of patients with advanced cancer. The goal of these and other types of service is to save lives and to help

patients and their families with the heavy burdens imposed by cancer.

Together, the carefully planned programs of research, service, and education, represent a total attack on the cancer problem, offering maximum opportunity for saving lives today and great hope for the future.

New Tear Gas Developed

➤ DEVELOPMENT of an improved tear gas, so effective that those who have tested it are rarely willing to try it twice, has been announced by the Department of the Army.

The gas causes no permanent injury and its effects wear off quickly in fresh air. It has not yet been named.

Although discovered by two Americans, the British have been leaders in the development of the new gas. The United States Army has conducted tests on volunteers of various ages and health to determine its toxicity, and also has developed means for dissemination.

The gas causes severe burning and watering of the eyes, irritation of the respiratory passages, a burning sensation on moist areas of the skin, painful forced coughing, and involuntary closing of the eyes.

Since this is an effective tear gas, it also has possibilities for use as a chemical warfare training aid in that it has a quick, positive effect and could be used as a harmless simulant for war gases. Dispersal even in small concentrations — one part gas to one million parts of air — causes extreme discomfort instantaneously upon exposure.

The gas can be delivered in a grenade that disperses it either as a smoke cloud or in aerosol form, or it can be delivered by any of the devices used to spread conventional tear gas. Used as a training aid, or to test the fit and performance of protective masks, it is prepared in a gelatin capsule.

Extensive testing by the Army with soldier volunteers has revealed no evidence of injury.

Meat Flavor Isolated

➤ Two U. S. Department of Agriculture scientists have isolated and freeze-dried substances that give beef and pork their flavor and aroma.

The substance could add flavor to the unappetizing algae that may be grown in interplanetary manned space ships as food for astronauts.

The research was done by Irwin Hornstein and Patrick F. Crowe who work in the Department's Eastern Utilization Research and Development Division at Beltsville, Md.

They used cold water to extract the flavor substances and then freeze-dried the extract into a powder. When heated, the powder produced the rich aroma of roast meat.

The studies showed the main meaty flavor of meats is in their lean parts. On the other hand, the crucial flavor elements that give pork and beef their distinctiveness are found in the fatty portions.

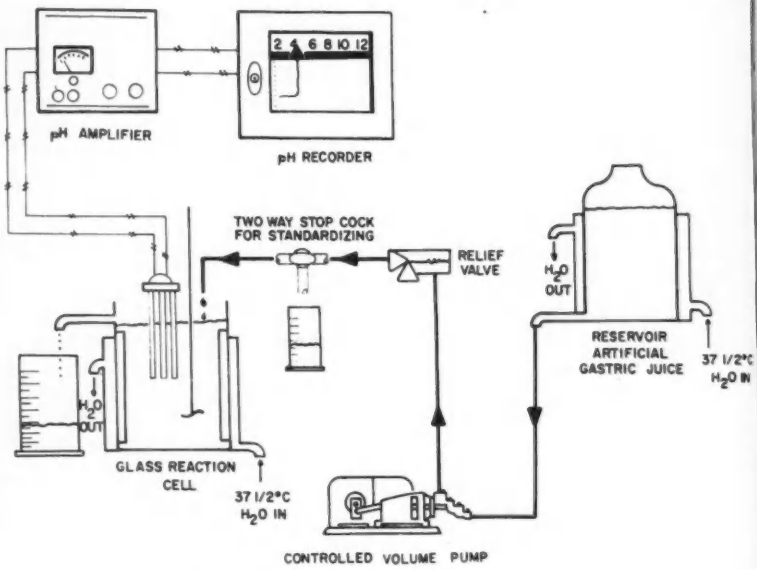
Apparatus Article

Artificial Stomach

➤ AN ARTIFICAL stomach gurgling quietly in a secluded corner of Reheis Co.'s antacid research laboratory has been turning out vital information for this bulk chemicals producer for more than a year.

A complex combination of beakers, rubber and glass tubing, valves, and electrodes, the "stomach" is a highly consistent performer, which with the help of a strip chart recorder manufactured by the Weston Instruments Division of Daystrom, Incorporated, has been turning out litarally reams of data on virtually every brand and type of antacid known.

So closely does the instrument simulate actual human reactions to antacids that many chemical producers and suppliers have been to the Reheis laboratories for impartial testing of their products.



➤ THE ABOVE *is a diagramatic representation of the Reheis Company's artificial stomach for simulating pH reactions in the human stomach to given doses of various antacids.*

Stewart M. Beekman, director of engineering and development at the company's plant in Berkeley Heights, N. J., calls the artificial stomach or gastronometer "an engineering approach to a biological phenomenon." At the start of each test, the gastronometer is given a dose of antacid, and an interval timer and the strip chart recorder are put in operation. Indications of pH level through electrodes inserted in the apparatus are recorded by the strip chart recorder as a function of time.

The result, usually after a minimum of two hours, is a complete record of an antacid's activity over the period in which its neutralizing action would be effective in a human user's stomach.

The apparatus, developed by Mr. Beekman, derives its almost human activity from an ingenious method of reproducing the mechanics of stomach action.

The central container, a glass reaction cell, is equipped with a constant speed agitator and pH electrodes. At the beginning of each trial it is filled with 150 millimeters of artificial gastric juice. The pH meter and the potentiometeric recorder are started up and, after ten minutes, more artificial gastric juice is pumped into the reaction cell at the rate of 120 ml per hour to simulate the fresh liquid constantly formed by the stomach. Simultaneously, a tube in the cell permits the mixture of antacid plus gastric juice to overflow at the rate of 120 ml per hour, simulating the normal loss of contents from the stomach.

According to Mr. Beekman, "The system is one which is gradually being depleted of antacid while fresh gastric juice is continually being added. It is difficult to conceive of a more stringent test for an antacid."

The automated test system makes for a high degree of reproducibility and serves to make accurate comparisons between various antacids similarly treated. Charts supplied by the potentiometric recorder have a lasting research value and, for future reference, the records for each chemical tested are bound.

The gastronometer method is more effective than experiments with living persons. Experiments designed to derive results of using antacids in living stomachs have been generally unsuccessful — mainly because the stomach balks physiologically when forced to accept the necessary pair of electrodes.

On the Back Cover

➤ Our back cover *this month shows Laboratory technician Henry Nowak adjusting the potentiometric recorder. Mounted above the gastronometer, the recording instrument provides vital charted data on simulated stomach reaction to given doses of antacid. The research data has assisted in improving a number of present antacid pharmaceuticals.*

For the Home Lab

Urinalysis

by Burton L. Hawk

➤ Many times a visit to the doctor will result in the inevitable request for a sample of urine. This is not done simply to inconvenience the patient; the doctor has a good reason for the request. Medical science has found that many pathological conditions of the body can be detected through urine examination. For some diseases, this is the only reliable method of diagnosis.

Several urine tests are relatively simple and can be performed in the home laboratory. First, a word of caution. If you attempt these tests and find your urine results in positive reactions, do not panic. This does not mean that death is imminent. Try the tests several times on different samples. If positive results persist, then we suggest you see your doctor.

Normal urine is clear, pale straw to amber color, has a specific gravity of 1.005-1.022 and is faintly acid. You can test the acidity with litmus paper. Although the urine is usually slightly acid (litmus paper turns pink), it may sometimes be alkaline for several hours after meals.

Albumin:

The presence of albumin in the urine may indicate kidney trouble. We are listing below several tests designed to detect albumin:

1. To 6 cc. of urine in a test tube, add 1 cc. of 37% formaldehyde. The solution becomes turbid if albumin is present and this turbidity is increased by boiling.

2. Prepare the test reagent by dissolving 4 grams of mercuric chloride, 2 grams of tartaric acid and 10 grams of cane sugar in 100 cc. of water. Carefully float the urine above this reagent in a test tube. A white ring forms where the two liquids meet if albumin is present.

3. Prepare a 5% solution of calcium hypochlorite. Place 5 cc. of this solution in a test tube and add 2 drops of hydrochloric acid. Now carefully pour the urine into this mixture. If albumin is present, a bluish cloudiness is formed immediately.

4. Mix together equal quantities of glycerine and phenol and add to the urine. Again, a turbidity or precipitate indicates albumin.

Glucose:

The presence of glucose in urine may indicate a form of diabetes.

1. Benedict's Solution is the popular reagent for this test. It is prepared as follows: Dissolve 20 grams of sodium citrate and 11½ grams of anhydrous sodium carbonate in 100 cc. of hot water in a large beaker. In another container dissolve 2 grams of copper sulfate in 20 cc. of water. Add this slowly to the carbonate-citrate mixture, with continual stirring. Filter the mixed solution.

Add 5 cc. of Benedict's Solution to 8 drops of urine in a test tube. Boil very gently, preferably in a water bath, for 5 minutes. The solution will remain blue if no glucose is present.

A yellow-green precipitate will appear if less than 0.5% glucose is present. A greenish yellow precipitate of lighter hue will indicate a maximum of 1%; a yellow precipitate 2%; and an orange-red precipitate more than 2%. Other reducing sugars, such as levulose, lactose and pentoses will also give a positive reaction.

2. Mix 3 cc. of urine with an equal quantity of water and add 0.1 gram of phenylhydrazine hydrochloride and 0.5 gram of sodium acetate. Heat the solution to boiling and add 10 cc of 10% sodium hydroxide solution. A pale red to red color will indicate that glucose is present.

Blood:

The presence of blood in urine may indicate internal bleeding from a variety of causes. If blood is present, it is best to let the physician make the diagnosis.

1. Add 2 cc. of urine to a mixture of 1 cc. fresh 3% hydrogen peroxide and 3 cc. of a saturated solution of Benzidine base in glacial acetic acid. The presence of blood (hemoglobin) will cause a blue or green color to form.

2. Mix the urine with an equal volume of hydrogen peroxide. Add a little powdered aloin, shake vigorously, and heat. A purple-red color is formed if blood is present.

Other Tests:

Aminopyrine: Mix 1 cc. of tincture of iodine with 10 cc. of water and carefully float this solution on top of urine in a test tube. If aminopyrine is present, a brown-red ring will develop after some time.

Bile: First prepare some barium test paper by soaking strips of filter paper with a 10% barium chloride solution and drying. Dip the lower $\frac{1}{4}$ inch of such a strip in the urine for 5 or 10 seconds. Then remove and lay the strip on white absorbent paper. Place a drop of Fouchet's reagent at the brown line which marks the level of immersion. A green color indicates the presence of bile. (Fouchet's reagent is prepared by dissolving 5 grams of trichloroacetic acid in 20 cc. of water and adding 2 cc. of 10% ferric chloride solution).

Bromine: Again, test papers must be prepared. Soak the filter paper strips in a solution of 0.5 gram p-dimethylphenylenediamine in 500 cc. of water and then allow to dry. Place 10 cc. of urine in a flask and acidulate with sulfuric acid. Add potassium permanganate until the red color does not disappear. Now suspend a piece of test paper in the neck of the flask and warm the solution. If bromine is present the vapors will form a colored ring on the paper, violet in the center and blue-gray or brown toward the margin.

Acetone: Mix thoroughly together 25 grams of powdered ammonium sulfate with $\frac{1}{4}$ gram of sodium nitroferricyanide. Place one gram of the mixed powders in a dry test tube and add 5 cc. of urine. Dissolve the powder by shaking gently for a few minutes. Then slowly and carefully pour 28% ammonium hydroxide down the side of the tube so that it floats on top of the urine solution. A red-purple ring forms where the two liquids meet if acetone is present.

Levulose: Add 1 cc. of concentrated hydrochloric acid and 10 drops of a 20% alcoholic solution of diphenylamine to a small quantity of urine in a test tube. Boil the mixture for about

a minute. Levulose present will produce a blue color.

Glycogen: Mix 45 cc. of urine with 5 cc. of a 40% potassium hydroxide solution. Filter; then add 5 grams potassium iodide and 25 cc. of alcohol. If glycogen is present, a flocculent precipitate will form.

Peptone: Prepare the test reagent by dissolving 1 part of ammonium molybdate and 4 parts of citric acid in 40 parts of water. If the urine is not acid, make it so by the addition of citric acid. Add a drop of the reagent to 4 cc. of acidified urine. A turbidity will form which will disappear on warming.

The above tests are by no means all that are available. They were chosen because they required a minimum of equipment and could be done at home. More complex tests are performed by professional laboratories, as confirmation to the above.

Remember, these tests are given as a guide only and are not intended to be of professional caliber. And, we repeat, if you obtain consistent positive results, seek medical advice.

√ *Chemistry Quiz* √

Directions: Mark the answer you think *most nearly correct.*
Answers are on page 36.

A. Zeolite crystals are *not* useful as
1. carriers for volatile catalysts
2. dehydrating devices
3. semi-precious gems
4. separators for different types of molecules

B. A headline in 1959 said "LIPID RESEARCH LABORATORY SET UP." Which of the following materials or problems would be *most* likely to be studied in this laboratory?
1. amino acids and reproduction
2. fatty substances and heart trouble
3. radioactive tracers and tissue structure
4. tars and lung cancer

C. Primary cosmic radiation is composed mainly of
1. electrons and mesons
2. electrons and photons
3. protons and heavier nuclei
4. protons and neutrinos

D. In which of the following sciences is *chitin,* which is chemically inactive, most likely to be studied?
1. biochemistry
2. geology
3. ichthyology
4. petrology

E. *Taconite* is an extremely hard rock, of value in the production of
1. carborundum
2. cement
3. iron
4. talc

Complete copies (with answers and norms) of many previous Science Talent Search examinations are available at 15c each from Science Service, 1719 N St., N.W., Washington 6, D. C.

New Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupon (but not stamps) for each patent ordered.

Airplane Deicer Explodes Ice Off

➤ A NEWLY patented airplane deicing system removes wing ice by exploding it off. It has the advantage of being externally attachable or removable at will.

A miniaturized detonating cord is secured to the leading edge of an airfoil, such as a wing, by pressure-sensitive tape. A detonating unit with a suitable initiating cap attached to one end of the cord has wire leads to connect the cap into a detonating circuit by means of quick-disconnect plugs at the junction of the wing and fuselage. The circuit may be energized from the plane's electrical system and actuated by a switch in the cockpit.

The deicing system is thus externally applied and may be attached or removed at will. It is claimed by its inventor, Herbert C. Johnson of Minneapolis, to be lightweight, reliable, and to have comparatively low drag characteristics.

Because high-altitude, supersonic aircraft normally operate above altitudes where icing usually occurs, and attain speeds where aerodynamic heating precludes ice formation on wing edges, conventional, built-in deicers may offer more design problems than they are worth.

All that is needed here, Mr. Johnson believes, is a system that can be selectively or periodically actuated upon ascent or descent through ice forming layers of the atmosphere, which his system accomplishes. He reports it may be used on all types of modern aircraft under even the severest conditions. He received patent No. 2,930,554 and assigned rights to the U. S. Air Force.

Simple, Reliable, Portable Liquid Fuel Reactor

➤ PATENT No. 2,929,767 has been awarded to the inventor of a new atomic reactor. This one is a "homogeneous nuclear reactor" using a liquid fuel.

Invented by R. Philip Hammond and L. D. Percival King of Los Alamos, N. M., and assigned to the Atomic Energy Commission, the reactor is described as particularly suitable for use in the production of power where a compact, simple, reliable, portable reactor, capable of safe unattended operation, is required.

The reactor does not require the use of control rods, extensive recombination apparatus, or mechanical fuel circulating apparatus.

Two New Methods Cut Auto Fumes

➤ TWO ATTEMPTS at controlling and eliminating noxious, smog-producing

exhaust fumes given off by motor vehicles have won patents.

One is an aluminum filtering attachment that fits on the end of an automobile's exhaust pipe. The other is a method of feeding into the exhaust pipe chemicals that will react with the gases and render them less objectionable.

The filter attachment, invented by Jose L. Villasenor and Raul H. Leon of San Diego, Calif., consists of four connected chambers. One circulates air taken in by the rapid forward motion of the car. A second chamber mixes this air with the gases coming from the exhaust pipe. In a third chamber the noxious fumes are absorbed and reduced by mixing with castor oil. The last chamber provides final purification and cleansing.

This purification attachment is claimed to be easily attached and removed, simply manufactured, effective and durable. The inventors received patent No. 2,932,157 and assigned one-third of the patent rights to James B. Abbey, also of San Diego.

The method of mixing chemicals with the ejected fumes was invented by Frederick C. Binter of Moorestown, N. J. It is claimed to purify the exhaust from both diesel and gasoline internal combustion engines, and to drastically reduce objectionable odors and irritating substances.

Mr. Binter accomplishes this by injecting into the exhaust pipe, preferably as far from the outlet end as possible, chemical derivatives of ammonium salts, which may be either liquids or solids that are water soluble. If a continuous flow of such chemicals is intimately mixed with the exhaust fumes as both pass through the pipe, he says, they remove or convert the noxious substances in the exhaust gas and result in a product that is neither foul-smelling nor irritating to the eyes.

The chemicals added to the pipe may be held in a refillable container mounted at the rear of the vehicle and fed to the exhaust pipe by direct pipes. The invention earned patent No. 2,932,364.

Hot Aircraft Cooled In Refueling

➤ Raymond E. Greenough of Berea, Ohio, has been granted patent No. 2,930,553 for a method of cooling aircraft.

At speeds faster than sound, a plane encounters such high skin temperatures that it is necessary to cool the pilot and certain accessory equipment even though the plane may be flying in a sub-zero environment.

Mr. Greenough, who assigned rights to his patent to Cleveland Pneumatic Industries, Inc., Cleveland, has figured out a way to cool a plane during mid-air refueling.

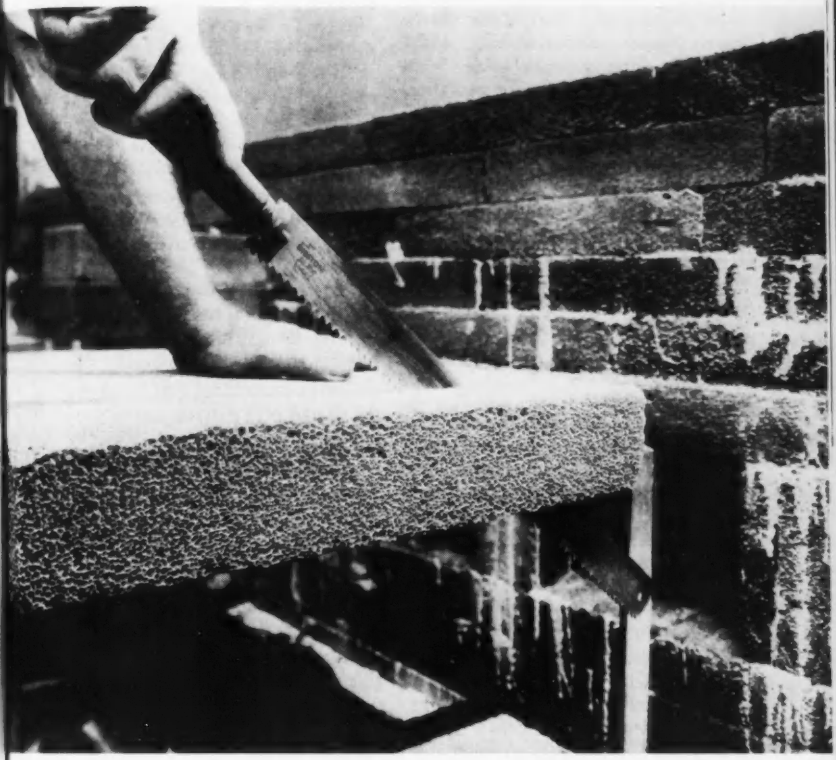
If the large tanker aircraft is flown at high altitudes to cool the transported fuel, the fuel may then be transferred cold to the plane that needs both refueling and cooling. This cold fuel may then be used as a sump for adsorption of the plane's heat. Apparatus within the plane enables it to best utilize the cold fuel for cooling purposes.

In this system, it is claimed, a large amount of cooling may be achieved without additional heavy equipment because the system uses, to a large extent, existing equipment within the plane.

New Light-Weight Silica Refractory

➤ BY USING a unique celluar silica material to insulate their new atmospheric brazing furnace, Pacific Scientific Company of Los Angeles, California, were able to save an amazing 80% of the estimated heating costs.

The furnace was designed for an aircraft subcontractor to be used in the manufacture of honeycomb aircraft and missile parts. Honeycomb



➤ THE NEW LIGHT-WEIGHT *refractory, Foamsil, is a multi-cellular form of 99 per cent pure fused silica glass. It may be cycled from —450 to +2,000 degrees Fahrenheit without thermal shocking, has a compressive strength of 200 pounds per square inch, weighs 13 pounds per cubic foot, and has a specific heat of only 0.277 at 1,200 degrees Fahrenheit. As may be seen above, the new material may be easily worked.*

sections up to 12 feet wide by 20 feet long by 4 feet in height can be handled in the furnace.

Key to the furnace's performance is a new, lightweight refractory, Foamsil, a product of the Pittsburgh Corning Corporation. The material is 99% pure fused silica glass foamed in a special, very high temperature furnace to create millions of tiny sealed cells. The material can cycle from —450°F. to +2000°F. without thermal shocking. It weighs only 13 pounds per cubic foot, yet has a compressive strength of 200 pounds per square inch.

However, the key factor is the material's low specific heat — only .277 at 1200°F. — combined with light weight. According to Mr. Harold E. Mescher, Director of Research and Development at Pacific Scientific, "Foamsil requires five times less heat to bring a given load up to temperature."

According to Mr. Mescher, the tremendous growth of the aircraft and electronics industries has brought with it complex problems in the design and manufacture of components to make them smaller and more heat resistant. This, in turn, has called for new concepts in furnace design — faster handling methods, automatic controls and consistently even heats. The art of brazing, itself, has become more complex by the day because the demand for these components has brought special stainless steels and rare alloys out of the research stage and into actual production.

The introduction of these metals has necessitated new brazing techniques and new furnace designs.

The problem is to make dependable brazed joints in these alloys on a production basis and with a minimum of rejects. To do this, a brazing furnace must provide accurately controlled heating and cooling cycles; in many cases, must allow components to be handled in the protective atmosphere of a retort; and must provide facilities for fast loading and unloading.

In designing the production brazing furnace, three honeycomb brazing problems had to be overcome — (1) the material had to be held very straight; (2) it must be heated to the desired temperature very rapidly; and (3) the heat must be taken out of it quickly to enable the braze to set.

The first problem was overcome by the design of a portable furnace which would move over the part to be brazed as it rests on upright rods and then backs away from it after the brazing operation.

"Foamsil" took care of the other two problems because of its low residual heat capacity, light weight and low heat storage capacity.

Apart from fuel and equipment savings, the large, but light celluar silica blocks enabled speedier installation with accompanying savings in labor costs.

Answers to CHEMISTRY QUIZ on Page 32.

A - 3; B - 2; C - 3; D - 1; E - 3.

King Cotton Learns New Tricks

In response to the challenge of new synthetic fibers, chemists are now working on processes to make cotton more versatile than ever. Among the newest developments are a cotton yarn that stretches like elastic, and bulk cotton fabrics that are as warm as wool.

➤ Rapidly increasing public acceptance of wash and wear, chemically finished cottons during the past few years has stimulated research discoveries in textile finishing that promise an entirely new look for old King Cotton.

According to the National Cotton Council nearly 50 per cent of all cotton apparel fabric produced in 1960 will be chemically finished for wash and wear and wrinkle resistant characteristics. This compares with only about 10 per cent in 1954 and 25 per cent in 1957. Last year U. S. Census estimates placed the total cotton chemically finished for wash and wear properties at 1.6 billion yards, a figure equal to about 37 per cent of all cotton goods finished for apparel uses.

This expanding market has led chemical companies and private research organizations to launch extensive studies of improved chemicals for the already accepted wash and wear field. New uses to create increased markets for wash and wear type chemicals and new chemicals for additional properties such as water repellency has promoted more industry research expenditure than any other phase of cotton textile processing.

Elastic Cotton

One of the new processes still in laboratory stages is a chemical-mechanical method of making high stretch cotton yarn. Commercial use of such a development would regain markets for many pounds of cotton lost to synthetic fibers following the introduction of stretch sox and other stretch garments. Cotton men say the stretch cotton would be more comfortable than the nylon.

Stretchability is achieved in cotton by twisting the yarn in one direction, curing it with a chemical finish, then reverse twisting. The result is a coiled spring-like yarn which after being stretched wants to return to coiled shape in which it was cured. The process is similar in principle to the Helanca method of making nylon stretch yarn except that the nylon is heat cured in the coiled position, whereas the cotton is cured by chemical cross-linking of the fiber molecules.

The chemicals used may be the same type used for regular wash and wear finishes. These are popularly known as resin finishes, but are actually resin precondensates because the curing process is not intended to form a resin.

What happens is that the resin molecules react with the cellulose molecules in the cotton fiber, forming bonds between the cellulose molecules. These inner bonds, known as cross-links, hold the fiber in the position it was cured, and return it to this position after it has been distorted.

Thus, a wash and wear fabric is

cured in a flat condition, and tends to return to this original condition after being wrinkled in the washing process or through wearing. The stretch yarn cured in a coiled condition, returns to this condition after stretching.

Wool-like Fabrics

Still another mechanical chemical process has passed initial tests for developing bulky cotton fabrics which will not mat down with use or after laundering. Cotton is spun into light weight, high bulk fabrics on woolen system carding and spinning equipment. Conventional resin finishing of this fabric would not be practical because it would be cured in a matted condition, but by fluffing the fabric during curing, such as in a tumble drier, it will come out with a "memory" for a bulky condition. The prospect of washable cotton with the warmth of wool opens uncountable market possibilities for increasing cotton consumption.

Research contracts sponsored by the U. S. Department of Agriculture were recently signed with two U. S. textile colleges for further investigation of stretch and bulky cottons. Meanwhile, the Department's Southern Utilization Research and Development Division in New Orleans reports that its research on a durable-to-all-types-of-laundering water repellent treatment for cotton has proved successful and that the finish is ready for release to commercial manufacturers. Until recently finishes on cotton rainwear needed to be renewed after several launderings.

Charles J. Conner, research chemist at the laboratory, reported on the silicone alloy treatment, which he claims does not give the fabric a stiff hand and which can be combined with wash and wear finishes. It seems to be very promising for treating cotton rainwear and upholstery.

Developments in finished cottons that have recently found their way to department store shelves include an increasing amount of chemically stabilized knit wear. The resin finish when applied to cotton knits prevents excessive shrinking and stretching, preserves the surface appearance of the fabric through repeated laundering and wearing, improves the wash and wear ability of the fabric, and improves wrinkle resistance of the fabric while being worn.

James B. Irvine, Quaker Chemical Products Corp., Conshohocken, Pa., a manufacturer of chemical finishes, told a group of chemists and finishers recently that, "Knit dresses, of which only 7 per cent were made of cotton in 1955, now claim 35 per cent of that market. In knitted nightwear, cotton garments have more than doubled their percentage of the market."

Soon to appear on the market are new epoxide finishes for wash and wear cottons which have demonstrated several advantages over earlier wrinkle resistant finishes. One advantage is an extreme durability to commercial laundering where strong acid sours are used.

Textile chemists say they have only penetrated the surface in development of more and better finishes for cotton. The day is not far off when consumers will demand that virtually all cotton apparel will have an easy-care or other type of chemical finish to enhance the natural qualities which have made it the world's most popular fiber.

Nitrogen Fixed Outside Cell

➤ FOR THE FIRST TIME researchers have duplicated in a test tube the reaction nature uses within a living cell to create the nitrogen compounds without which no life can exist.

They have discovered a technique, long sought by scientists around the world, by which nitrogen-fixing chemicals can be separated from bacteria and stimulated to perform their function outside the bacterial cell. Lacking such a technique, scientists have been frustrated in their research on this vital natural process.

Nitrogen as a gas is available in huge quantities in the atmosphere, but it can be used in this elementary form only by certain low forms of life. The nitrogen gas of the atmosphere is so unreactive that the chemist must use extremely high temperatures and pressures to "fix" it — convert it to chemical compounds which can be used by plants. It has long been known that some bacteria are capable of fixing the elementary nitrogen of the atmosphere at ordinary temperatures but how these bacteria do it has remained a nagging mystery. Scientists have agreed that discovery of some means of isolating from the living organism the chemicals that perform this operation would provide the key to the mystery.

Full understanding of this vital biological process is expected to answer many significant questions about the chemistry used by nature. It could also lead to greater farming efficiency and to increased food supplies in undernourished areas.

Research on the mechanism of nitrogen fixation in microorganisms has been carried out for several years at the Du Pont Experimental Station, Wilmington, Delaware, by Drs. James E. Carnahan, Leonard E. Mortenson, Howard F. Mower, and John E. Castle, all of whom are in the Central Research Department. The subject is being studied as one phase of Du Pont's efforts to learn more about the chemistry and physics of biological processes.

The earth's supply of fixed nitrogen must be constantly renewed since it eventually returns to the atmosphere. Some comes from mineral nitrate deposits, some is manufactured, some is created in the atmosphere by lightning. However, these sources are secondary and inadequate. For instance, industry produces about 10 million tons of fixed nitrogen annually for fertilizer, but that vast quantity is only about two per cent of the nitrogen needed by the world's fertilized crops.

Most fixed nitrogen used by plants and the animals feeding on them is produced by certain bacteria and algae, either independently or in association with plants like peas and clover. These microscopic one-celled organisms in the soil or water carry out chemical reactions which chemists today can match only in complex industrial equipment, using extremes of heat and pressure.

Since the middle of the nineteenth century scientists have been studying nature's method of fixing nitrogen, seeking better understanding of the mechanisms involved. They have generally agreed that it is performed by substances known as enzymes. De-

tailed study of the enzymes has been blocked because researchers could not extract them from living cells without destroying them.

The Du Pont research men overcame this barrier. They discovered that nitrogen fixation enzymes can be extracted from bacteria if strict requirements are met. First, the living cells of selected bacteria are broken open and the enzymes extracted under precisely controlled conditions to avoid damaging the delicate enzyme system. Second, a chemical fuel — pyruvic acid — is used to provide the necessary energy for the nitrogen-fixing reaction. Extracted enzymes then consistently carry out the process outside the cell bodies.

The discovery means that biological nitrogen fixation can now be observed in detail and should enable scientists to analyze the enzyme chemistry within the living cell.

When the bacterial processes are understood, one potential practical use is that man may be able to duplicate them economically or stimulate them artificially to increase farming efficiency. This knowledge may also advance the study of catalytic reactions in general because enzyme activity far surpasses man's accomplishments in this kind of chemistry.

It was also demonstrated that in bacteria of the type studied the end product of the fixation process is ammonia.

The experiments were facilitated by using "heavy" nitrogen, a rare form of the gas, in a technique developed by Professors R. H. Burris and P. W. Wilson of the University of Wisconsin.

Old Industry: New Techniques

➤ Long-term possibilities of using massive radiation doses as a means of curing (sterilising) hides and skins are being investigated in experiments being carried out in the Egham laboratories of the British Leather Manufacturers' Research Association (B. L.M.R.A.) in collaboration with the Technological Irradiation Group of the Isotope Research Division of the U. K. Atomic Energy Research Authority.

Curing methods in this old-established industry have changed little in essentials for hundreds of years. After the animal has been flayed, immediate attention must be given to arresting the putrefaction which begins almost at once in the hide or skin and which is caused by bacterial action. At present there are two main methods of doing this. The material may simply be dried in the sun until it becomes hard and stiff, like a board. This method is often applied, especially to goatskins, in tropical countries. While it is effective, it suffers from the disadvantage that it lowers the potential quality of the finished leather.

The other method, which has a number of variations, is to use salt. Since the B.L.M.R.A. was founded in 1919, there has been much research into the best type of salt to use for different classes of rawstock and the best methods of applying it. It is generally agreed however, that salting also has certain disadvantages, although it is greatly to be preferred to drying.

The possibility of using radiation techniques in place of salting as a method of preservation was first considered by the B.L.M.R.A. following the formation of the Technical Irradiation Group of the U. K. Atomic Energy Authority in 1955. Only X-rays or penetrating gamma rays seem to be promising. The main advantages are:

1. Highly efficient inactivation of micro-organisms and other forms of life is possible.

2. The rise in temperature is small.

3. Appreciable thicknesses of material can be treated in diverse containers.

4. The process lends itself readily to continuous operation.

The main disadvantages are:

1. The cost of the process depends upon the continuity of the process because the capital cost necessitates 24-hour operation.

2. The radiation dose which appears to be necessary ($2\frac{1}{2}$ million rads) causes some loss in strength of the skin fibres and a fall in shrinkage temperature. Such changes also occur to some extent in the conventional liming process and therefore may not necessarily be an objection. Current results indicate that $2\frac{1}{2}$ million rads will be adequate.

Some calfskins cured by irradiation at Wantage have been processed in a tannery using a normal commercial tannage and have made reasonable leather.

The scientists and tanners who carried out this preliminary experiment believe that the leather could have reached commercial standards, given suitable process modifications.

Taking a long-term view, it is of interest that a process modification which might arise in the future as a result of using irradiation is the partial elimination of liming. For hundreds of years this has been an essential feature of the leather making process — its purpose is to facilitate the removal of hair and unwanted proteins before tanning begins.

In recent years, much attention has been given to the elimination of this process which gives rise to troublesome effluent problems.

Another interesting feature is that radiation can be used to kill anthrax spores.

While it is true that conventional methods of sterilisation have reduced the incidence of anthrax in the hides, skins and leather trade to a low level there is no doubt that radiation is technically superior for this purpose.

To sum up, it appears that radiation may not be generally adopted as a curing method for some time to come.

This is very largely a result of economic considerations which means that the expensive plant could only be used at one or two major centres, an arrangement which cuts across the present organisation of the trade. On the technical side, although there are some difficulties to be overcome there is nothing to suggest that they are insuperable and should the economic picture change, further developments would be likely.

The industry's research organisation is continuing to investigate the technical problems on an experimental scale.

Military Chemicals Studied

➤ MEDICAL RESEARCH at the Army Chemical Center in Edgewood, Md., largely concerned with studying the chemical agents of warfare, for ten years has been carrying on a laboratory campaign aimed at preventing toxic injury resulting from new defense materials.

The Health Hazards of Military Chemicals Project was set up to obtain information through laboratory research on the poisonous effects of many chemical materials used by the Army, Navy and Air Force so that measures can be taken to protect the health of military personnel, civilian employees of the military, and government contractors.

Some of the military chemicals scrutinized during the ten-year period have been products of the space age — the rocket and missile propellant fuels and oxidizers, and fuels for modern air-breathing aircraft engines.

Others have been old compounds and old problems — fire extinguishants, hydraulic fluids, solvents and cleaners, for instance.

The advent of high-performance aircraft brought its special problems; the pollution of cabin air by hydraulic fluids and heated engine oil is one of them. Emphasis on this aspect of chemical hazards was increased with man's high altitude ventures since, more and more, man is being required to work in confined space.

The Army Chemical Warfare Laboratories scientists have recently turned the spotlight of research on an aspect of carbon monoxide poisoning, a problem that came in with the internal combustion engine and lingered to plague modern aircraft and other military operations. The new research efforts were directed to a determination of the effects of exposure to carbon monoxide without relief — for example, for 24 hours a day, seven days a week.

The laboratory tests resulted in information on safe levels for continued exposure of man to carbon monoxide. Dogs, rats and rabbits exposed continuously to low concentrations over a three-month period showed no harmful effects and these findings, balanced against known human experience, gave the researchers a determining gauge.

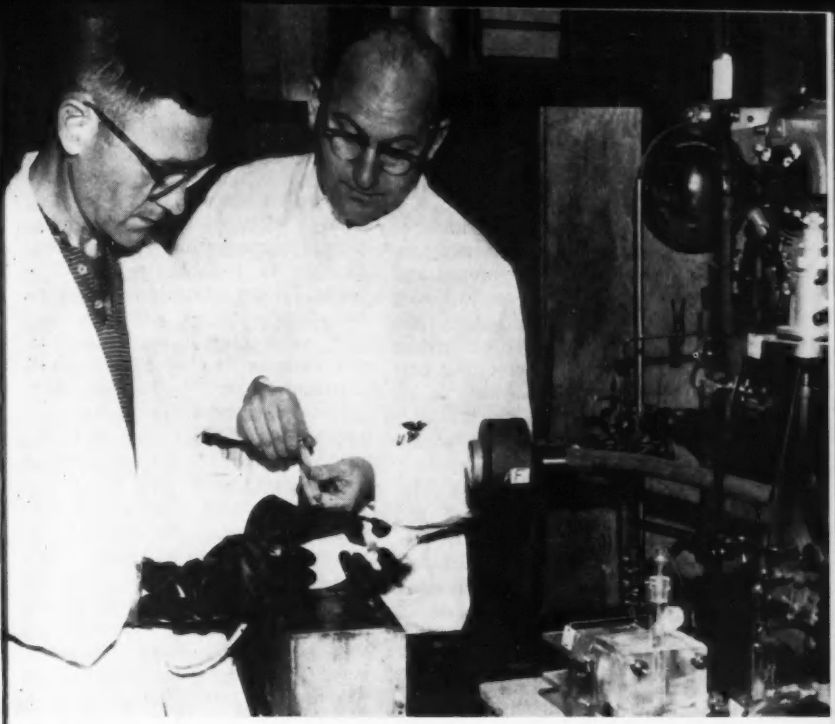
On such courses goes the fascinating laboratory exploration of the myriad mysteries of rapidly developing new chemical compounds, as well as the reviews of older materials, as science seeks ways to protect the men who use the military chemicals.

Research Staff

Backing up this important research is the Army Chemical Warfare Laboratories' expert staff of pharmacologists, toxicologists, pathologists and other specialists in the extensive Medical Research Directorate.

The project officer is Dr. Keith H. Jacobson, formerly of Yankton, S. D., and a World War II Navy veteran with a doctorate in protein chemistry. Dr. Jacobson maintains close liaison with the Army, Navy and Air Force while coordinating the laboratory work.

Across his busy desk come the challenging questions of chemical health hazards arising in the three services



➤ MAURICE H. WEEKS *(left) holds a laboratory rat and Nelson P. Musselman draws a blood sample as the U. S. Army Chemical Warfare Laboratories scientists check the effect of carbon monoxide on the animal as part of the researchers' Health Hazards of Military Chemicals Project. The project is aimed at preventing toxic injury to persons using military materials involving chemical compounds.*

and, after laboratory investigation, he feeds back the information needed to guide the services in coping with their problems.

The special project was conceived in the late 1940's when other Department of Defense laboratories began to call on the diverse medical research facilities for toxicity studies of several chemical materials, especially the new propellants.

As the requests increased, the Health Hazards of Military Chemicals Project was established by the Chemical Corps Technical Committee in 1949, with Dr. William H. Chambers as coordinator.

Much of the toxicological information emanating from the project is also available to occupational health specialists in private industry, as it is presented in scientific papers and reports as well as in various military health and safety manuals.

Interlingua

The following is a translation of the article in Interlingua on page 23.

Water

➤ H_2O IS THE chemical formula of water. One molecule of water consists of two atoms of Hydrogen and one atom of Oxygen. Free hydrogen is rare on Earth. It is abundant in the Sun and in other stars. Free Oxygen comprises more than twenty per cent of our atmosphere. We breath in order to introduce Oxygen into our blood. Without Oxygen we are not able to live.

We are also not able to live without water. It is abundant on Earth. Apparently no water exists on the moon. It is certain that none exists in the Sun. We do not know whether or not water exists in other stars.

We normally think of water as a liquid. We bathe in it. We drink it. We use it in our industries. In the form of rivers and oceans, it makes easy for us the transport of great cargoes.

The substance which we call water when it is a liquid occurs also as a solid and as a gas. The solid form of water is called ice. The gaseous form of water is called vapor. Ice, water, and vapor are chemically identical. They are all H_2O.

Whether water is solid, liquid, or gaseous, depends upon the temperature. The temperature at which water changes to a vapor is the boiling point. The temperature at which water changes to ice is the freezing point. The temperature at which vapor changes into water is the condensation point. The temperature at which ice changes into water is the melting point. The boiling point and the condensation point are identical. The freezing point and the melting point are identical. The scale of temperature between the melting or freezing point and the boiling or condensation point is divided into a hundred degrees according to the system invented by the Swede Celsius in the year 1742. These degrees are numbered from zero to a hundred. In America we rarely use the Celsius system. We prefer the system invented in 1709 by the German Fahrenheit. According to this system, water becomes ice at 32 degrees and vapor at 212. The distance between the two is one hundred and eighty degrees. In a third system — that invented in 1730 by the Frenchman Réaumur — the same range is divided into eighty degrees.

New Weight for Silver

➤ AN ATOM of silver weighs less than previously thought, but this new finding of the National Bureau of Standards here will not affect the silver dimes in your pockets. A dime will still be worth ten cents.

The new atomic weight of silver was set at 107.873 through accurate measurements with a mass spectrometer. The atomic weight currently used is 107.880.

The more precise atomic weight of silver may mean that the atomic weights of other elements may have

to be adjusted. Silver has been used to set the atomic weights of certain other elements.

What makes the new measurement significant is the fact that the mass spectrometer was calibrated to extraordinary accuracy through use of known mixtures of the two highly purified silver isotopes.

The new atomic weight of silver was obtained by ionizing a sample of silver and shooting these ions through a magnetic field.

Silver occurs as two natural isotopes having relative weights of 107 and 109. Ions of the lighter isotope, 107, are deflected to a greater extent by the magnetic field of the mass spectrometer than those of the heavier isotope, 109. This enabled scientists to separate into groups and collect the 107 and 109 ions. By doing this and measuring the relative abundance of each, the new figure, 107.873, was arrived at as the atomic weight of silver.

Element 103 Due Soon

➤ SCIENTISTS hope to be able to create element 103 before the end of April.

Dr. Albert Ghiorso of the Lawrence Radiation Laboratory, Berkeley, California, believes that discovery of the new element is only "a question of time." The University of California scientists who have discovered many of the transuranium elements of the atomic age believe they will succeed shortly in making another one, which will then be the heaviest known.

He said the California team had been trying to make element 103 for the past few months, and hope to announce its discovery at a meeting in Gatlinburg, Tenn., the first week in May. The method consists in bombarding a target element in such atom smashers as the Berkeley HILAC.

B_4Si Prepared in Bulk

➤ LARGE QUANTITIES of the little known compound tetraboron silicide, B_4Si, can now be prepared for the first time.

Dr. Ervin Colton of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., reports in the Journal of the American Chemical Society that this compound in reasonably pure form is obtained when a mixture of the elements boron and silicon is heated in an inert atmosphere at between 2,200 degrees and 2,500 degrees Fahrenheit.

Objects made from the powdered compound have been shown to be highly resistant to oxidation at 2,500 degrees Fahrenheit due to a protective film that forms on exposure to the air at high temperatures. It also showed excellent thermal shock resistance in that no cracks appeared when the objects were cooled rapidly from that high temperature to room temperatures several times.

The ceramic properties of tetraboron silicide are at present being investigated.

New Ore Deposit Studied

➤ Geologists and metallurgists representing several major North American and European industrial corporations and scientific research institutions have completed an on-the-scene inspection of the newly-opened cesium-bearing pollucite ore deposit at the Montgary mine operation of Chemalloy Minerals, Ltd., in the Bernic Lake area of Manitoba, Canada.

Members of the research party which examined the Bernic Lake mine and pollucite ore deposit included experts from the Dow Chemical Company, American Metal Climax Corporation, Metallgesellschaft A. G. of Frankfurt, Germany, the University of Manitoba.

The deposits include lithium and beryllium bearing ores in addition to to cesium-containing pollucite; as well as ores bearing varying amounts of tantalum, columbium, gallium, and tin, the economic development of which is under study. In addition, Chemalloy produces quartz aggregate for the building industry.

Cesium and beryllium, however, appear at the moment to offer the most exciting prospect for development from ores either discovered or being already mined at Bernic Lake.

Dramatic and widely publicized events in 1959 are said by geological and metallurgical authorities to foreshadow a future for cesium more promising than was that of uranium a dozen years ago. These same experts see in 1959 production and experimental activities planned for this year the possibility of a boom in beryllium as a "wonder metal" to end all "wonder metals."

It is significant that David O. Woodbury writing in the February issue of Science Digest said, "So far, cesium has been used literally by the spoonful to accomplish a wide variety of vital services in high speed communication and ultra-fine measurement . . . Now, suddenly, we need thousands of tons of it. There has been a break-through in atomic physics and cesium is the principal actor."

The Pollucite ore deposit at the Chemalloy mine in Manitoba is the only one of commercial extent known to exist in North America and has been estimated to be potentially the richest single source of cesium in the world. It was discovered only two years ago and evaluated through diamond drillings just last June.

The cesium-bearing deposit main body was finally reached a month ago from a shaft sunk 335 feet below earth surface and a 700-foot cross-cut driven under the lake on a 285-foot horizon below the lake bottom. By the end of January, bulk samples were being taken out and operations were begun to work the mine further from another sub-level.

On the basis of drill indications, the deposit is estimated to contain about 200,000 tons of pollucite averaging 25 to 30 per cent Cs_2O and 1 per cent Rb_2O (scientific symbols for cesium and its cousin alkali element, rubidium). Pure cesium, which is in short world supply, has a current market value of approximately $540 per pound.

At about the time the cross-cut to known Bernic Lake pollucite deposit

was being completed, a theretofore unidentified mineral occurrence was encountered. Analysis has proved this ore to be beryl.

The potentialities of the Bernic Lake cesium deposit have not been lost on independent prospectors, who have already staked claims adjoining the Chemalloy property situated on strike and along favorable contact, and are publicly offering them for development.

The cesium situation today resembles that of uranium in the 1940s when uranium reserves and production were centered in one mine in the Belgian Congo and consumption was restricted to a few tons of ore. Last year, in excess of 40,000 tons of contained metal uranium were produced, more than the world could consume; and ore reserves in the United States alone surpassed 89 million tons of 0.27 per cent uranium oxide.

However, cesium is currently linked with uranium in two developments of immense possibilities: Production of power through ion propulsion for space missiles and rockets, and production of electricity directly from heat through thermionic conversion.

Scientists are working on and reportedly have developed an ion motor using cesium; and it was publicly made known in December that some 10 private rare metal refining companies were working under Federal government contracts totalling some million dollars to develop cesium fuel as a booster for projectiles and satellites. But the limited supplies of pure cesium were cited as a serious bottleneck in the projects.

In April last year, it was revealed that U.S. Atomic Energy Commission scientists had succeeded with experiments begun in 1958 in generating direct current electricity from a plasma thermocouple utilizing liquid cesium and U 235-enriched uranium. Then, at the beginning of this year, scientists of the General Atomic Division of General Dynamics Corporation converted heat directly into alternating electric current by use of high temperature cesium cells.

This project had been partially supported financially by nine leading public utilities companies of the Pacific Coast and Rocky Mountain region.

The implications of these latter achievements are enourmous. A cesium-using thermionic converter on a large scale installation would eliminate steam-producing, steam-conversion units in power stations, simplify design of the nuclear reactor itself and cut operating and capital costs in half.

Some scientific authorities are predicting 10,000 to 30,000 tons of uranium consumption a year within two decades and believe there might be a similar development in the cesium mineral field during the same period of time.

As for beryllium, a new high in consumption was reached in 1959. The metal has received widening attention in the technical press and a possible "boom" could grow out of any one of three developments, according to competent authorities.

These could be location of a spectacular ore body of easily hand-cobbed beryl, introduction of a low cost flotation or electrostatic separation method for recovering fine crystalline beryl or other beryllium ores, or development of a ductile beryllium.

Book Condensations

ACRYLIC RESINS — Milton B. Horn — *Reinhold,* 184 p., illus., $4.50. Describes manufacture, fabrication and applications of acrylic cast products, molding compounds, emulsion and solution compounds.

DATA FOR BIOCHEMICAL RESEARCH — R. M. C. Dawson and others — *Oxford Univ. Press,* 299 p., $10.10. Handbook on compounds, reagents and laboratory techniques, arranged in tabular form.

QUANTITATIVE INORGANIC ANALYSIS — R. Belcher and A. J. Nutten — *Butterworths (Canada),* 2nd rev. ed., 390 p., illus., $7. Laboratory manual for students and practicing chemists.

ANALYSTS POCKET BOOK — J. R. Majer — *Butterworths (Canada),* 100 p., $3.50. Quantitative information in compact form.

THE PLASMA PROTEINS, Vol. I: Isolation, Characterization, and Function — Frank W. Putnam, Ed. — *Academic,* 420 p., illus., $12.50. Authoritative, interpreative, and integrative account of the plasma proteins as a physico-chemical system.

EXPERIMENTS AND PROBLEMS IN GENERAL CHEMISTRY — A. W. Laubengayer — *Rinehart,* 311 p., illus., $4.50. Laboratory manual and problem book.

PROCEEDINGS OF THE AEC SYMPOSIUM FOR CHEMICAL PROCESSING OF IRRADIATED FUELS from Power, Test, and Research Reactors; Richland, Wash., 1959 — G. F. Quinn and others — *AEC (OTS),* 455 p., illus., paper, $4.50. Separation processes for plutonium and uranium.

CAREERS AND OPPORTUNITIES IN CHEMISTRY: A Survey of All Fields — Philip Pollack, introd. by George M. Murphy — *Dutton,* 147 p., illus., $3.50. Tells boys and girls of educational requirements and opportunities in the chemical profession today.

SOVIET RESEARCH IN GLASS & CERAMICS, 1956: English Translation. Part I: Basic Science. Part II: Glasses, Glazes and Enamels. Part III: Cements, Limes and Plasters, Refractories, Miscellaneous — A. I. Avgustinik and others — *Consultants Bureau,* 218 p., 43 p., and 52 p., paper, $30, $10 and $15; $40 per set. Collection of Russian technical papers through December 1956.

FORMATION AND TRAPPING OF FREE RADICALS — Arnold M. Bass and H. P. Broida, Eds. — *Academic,* 522 p., $16. Reference work on present status and techniques of free radical stabilization. Authors include physicists, physical chemists and chemical kineticists.

ESSENTIALS OF COLLEGE CHEMISTRY — Paul R. Frey — *Prentice-Hall,* 520 p., illus., $6.95. Brief course, using concept-building approach.

MOLTEN SALTS — Benson R. Sundheim, Ed. — *N. Y. Acad. of Sciences,* Annals, Vol. 79, Art. 11, 340 p., illus., paper, $5. Papers of recent research in molten-salt experimentation.

THE MERCK INDEX of Chemicals and Drugs — Paul G. Stecher, Ed. — *Merck & Co.,* 7th ed., 1641 p., $12. Expanded encyclopedia for chemists, pharmacists, physicians, and allied professions.

Chemistry Comments

Interesting facts in the chemical world.

➤ The pesticide industry has grown from an annual $30,000,000 business 25 years ago, to $280,000,000 today.

➤ A technique for using molybdenum disulfide as an ideal surface on which to study the fundamentals of the liquid state has been developed.

➤ Fluothane is an anesthetic which is nonflammable, nonexplosive, fast-acting, has low toxicity and causes less postsurgery sickness than ether.

➤ Trimethylamine is a decomposition product of a resin material and causes a strong "fishy odor" when used improperly in finishing clothing products.

➤ The Crab Nebula is believed to be the remnant of a star explosion and seems to derive its excitation from violent internal turbulent motions due to collisions between atoms and molecules.

➤ Superalloys are primarily nickel- and cobalt-base metals, capable of withstanding the high temperatures and thermal stresses of hypersonic flight.

➤ The Atomic Energy Commission will build an Experimental Gas-Cooled Reactor which will be used for testing gas-cooled reactor materials, fuels and coolants; at the same time it will produce about 29,500 gross electrical kilowatts.

➤ Glass does not have a definite melting point and chemists define it as a super-cooled liquid.

➤ Corinthian bronze is said to have been produced first in the Roman burning of Corinth in 146 B.C., when streams of molten copper, gold and silver mingled in the streets.

➤ High-purity tungsten can now be easily plated on metal surfaces by using a vapor deposition process.

➤ Polyethylene is the most frequently used plastic material in the world.

➤ Maleic hydrazide, or MH-30, is a growth regulant which stops sprouting in stored potatoes and onions; it is sprayed on the vegetables before they are harvested.

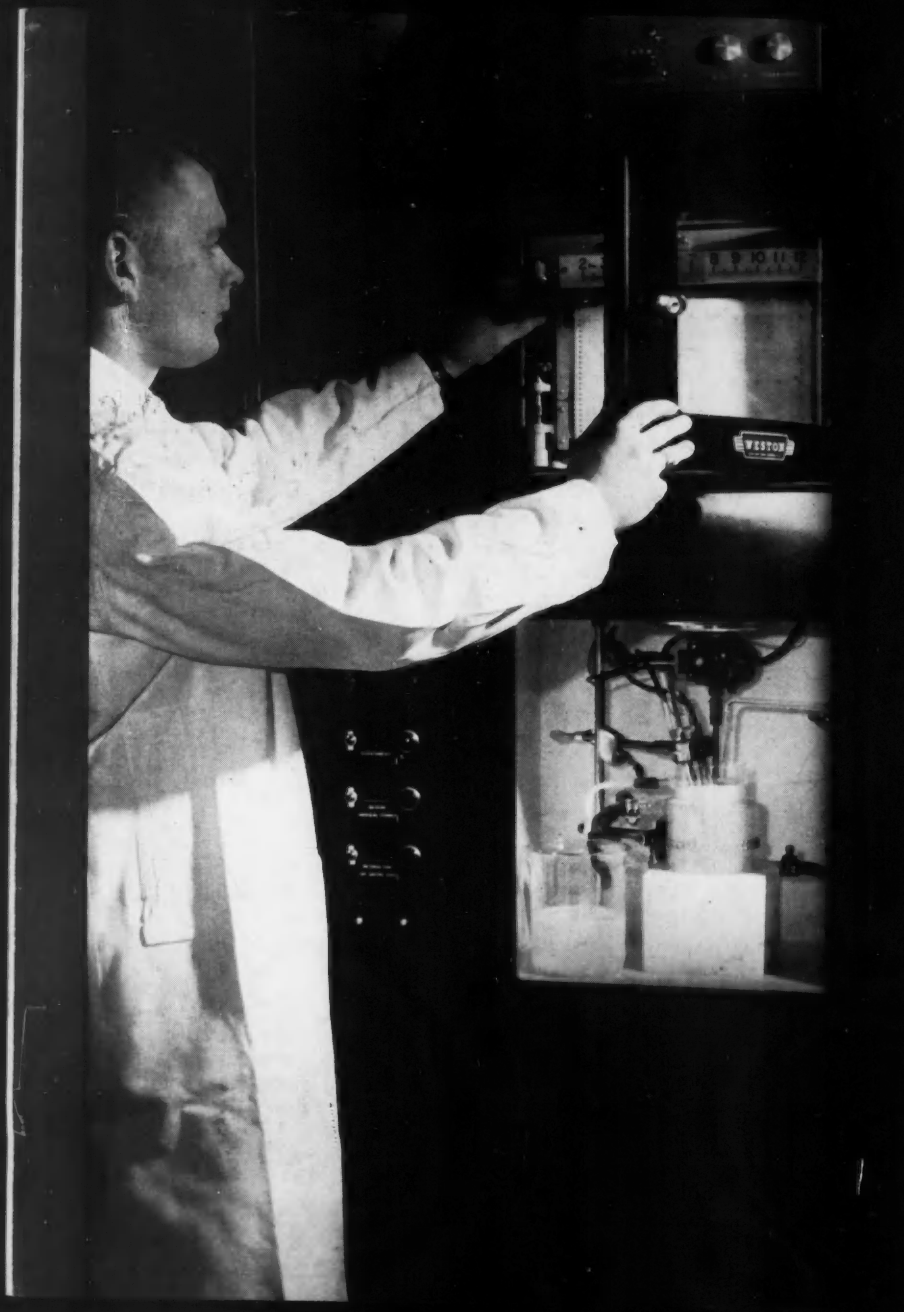
➤ Weapons-grade uranium and plutonium are the main materials used for nuclear weapons.

➤ Silicon nitride is a new British ceramic which can be heated to 1,000 degrees centigrade and then dropped into cold water without fracturing.

➤ The AEC's Experimental Gas-Cooled Reactor (EGCR), now being built at Oak Ridge, Tenn., will be cooled by helium, blown through the primary coolant system at the rate of 215,000 pounds per hour by two 3,000-horsepower blowers.

➤ Enrico Fermi and his team achieved the first nuclear chain reaction on Dec. 2, 1942, below Stagg Field at the University of Chicago.

➤ New chemical compounds are being introduced by industry at the rate of one every 24 minutes.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